UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

STEPHEN McCOLLUM, and SANDRA McCOLLUM, individually, and STEPHANIE KINGREY, individually and as independent administrator of the Estate of LARRY GENE McCOLLUM, PLAINTIFFS	§§§§§§§	
v.	§§§	CIVIL ACTION NO. 4:14-cv-3253 JURY DEMAND
BRAD LIVINGSTON, JEFF PRINGLE, RICHARD CLARK, KAREN TATE, SANDREA SANDERS, ROBERT EASON, the UNIVERSITY OF TEXAS MEDICAL BRANCH and the TEXAS DEPARTMENT OF CRIMINAL JUSTICE. DEFENDANTS	§§§§§§§	

Plaintiffs' Consolidated Summary Judgment Response Appendix

EXHIBIT 124

Centers for Disease Control and Prevention

MMWR

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Heat-Related Deaths After an Extreme Heat Event — Four States, 2012, and United States, 1999–2009

On June 29, 2012, a rapidly moving line of intense thunderstorms with high winds swept across the midwestern and eastern United States, causing widespread damage and power outages. Afterward, the area experienced extreme heat, with maximum temperatures exceeding 100°F (37.8°C) (*1*). This report describes 32 heat-related deaths in Maryland, Ohio, Virginia, and West Virginia that occurred during the 2 weeks following the storms and power outages. Median age of the decedents was 65 years, and most of the excessive heat exposures occurred within homes. During 1999–2009, an annual average of 658 heat-related deaths occurred in the United States (*2*). Heat-related deaths are preventable, and heat response plans should be in place before an extreme heat event (EHE). Interventions should focus on identifying and limiting heat exposure among vulnerable populations.

During June 30–July 13, 2012, an EHE occurred; maximum daily temperatures in Maryland, Ohio, Virginia, and West Virginia ranged from 83°F to 104°F (28.3°C to 40.0°C), averaging 9.5°F (5.3°C) warmer than normal (*1*). The EHE followed a series of powerful thunderstorms with wind gusts up to 80 miles (129 km) per hour that caused widespread damage across parts of the Ohio Valley and the Mid-Atlantic regions. The resultant power outages affected approximately 3.8 million persons and lasted 8 days in some areas. To describe the epidemiology of heat-related deaths that occurred during the EHE, information was collected from the state offices of the medical examiner or vital statistics. These offices analyzed death certificates and medical examiners' records and recorded deaths in which exposure to excessive heat either caused or significantly contributed to a death.* For comparison, a baseline number of heat-related deaths† in these four states over the same 2-week summer period each year of 1999–2009 was calculated using mortality data from CDC (*2*).

During June 30–July 13, 2012, a total of 32 deaths (0.11 deaths per 100,000 population) from excessive heat exposure were reported, including 12 in Maryland, 12 in Virginia, seven in Ohio, and one in West Virginia. In comparison, a median of four and average of eight (range: 1–29) heat-related deaths occurred in the four states during the same 2-week summer period each year of 1999–2009. The median age of the 32 decedents was 65 years (range: 28–89 years); 72% were male. Most decedents (75%) were unmarried or living alone. Common

* The underlying cause of death was defined as the disease or injury that initiated the chain of events that led directly and inevitably to death. Contributing conditions, or factors, were defined as diseases, injuries, or complications that contributed to the death and were a result of the underlying cause. A sample death certificate, showing underlying and contributing causes of death, is available at http://www.cdc.gov/nchs/data/dvs/death11-03final-acc.pdf.

† Deaths from excessive heat exposure were defined using codes from the *International Classification of Diseases, 10th Revision*. Such deaths included those in which exposure to excessive natural heat (X30) was reported as either the underlying or a contributing cause of death. Deaths from exposure to excessive heat of man-made origin (W92) were excluded. Guidance for certification of death is available in the *Medical Examiners' and Coroners' Handbook on Death Registration and Fetal Death Reporting* (2003 revision), available at http://www.cdc.gov/nchs/data/misc/hb_me.pdf.

INSIDE

Continuing Education examination available at http://www.cdc.gov/mmwr/cme/conted_info.html#weekly.

U.S. Department of Health and Human Services
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underlying or contributing conditions included cardiovascular disease (14) and chronic respiratory disease (four). In at least seven (22%) of the deaths, loss of power from the storms was known to be a contributing factor. Overall, 22 (69%) decedents died at home, with lack of air conditioning reported in 20 (91%) of these deaths. In the homes of five persons who died, a functioning air conditioner was present but not turned on. Of the seven deaths in which housing type was specified, six occurred in multifamily dwellings. Heat exposure occurred outdoors in three deaths, and two deaths occurred in a vehicle.

To compare the 2012 EHE with previously reported EHEs without concurrent power outages, a search was conducted using PubMed for reports of deaths from EHEs that occurred in the United States during the previous 20-year period. The search was conducted using the key words "heat wave," "extreme heat," or "extreme heat event" plus the key words "mortality" or "death." Only reports that covered a similar length of time (10–14 days) were included; a total of three reports met these criteria. During July 6–16, 1993, an EHE in Philadelphia, Pennsylvania, resulted in 118 deaths (7.5 deaths per 100,000) (*3*). Two years later, 514 deaths (9.7 deaths per 100,000) occurred during July 10–20, 1995, in Chicago, Illinois (*4*). In 2005, a 14-day heat wave resulted in 28 reported deaths (0.77 deaths per 100,000) in Maricopa County, Arizona (*5*). A lower fatality rate for heat-related deaths was reported in the 2012 EHE than in previous EHEs lasting 10–14 days. Public health and emergency management officials in Maryland, Ohio, Virginia, and West Virginia rapidly initiated preplanned heat response activities, which might have led to a decrease in the number of expected deaths.

To better understand the scope of heat exposure, mortality data for 1999–2009 (*2*) were used to review heat-related deaths in the United States overall. During this period, 7,233 heat-related deaths occurred, an average of 658 per year (Figure). In 5,201 (72%) of these deaths, the underlying cause was exposure to excessive heat, and heat was a contributing factor in the remaining 2,032 (28%) deaths. Heat-related deaths were reported most frequently among males (4,955; 69%) and among adults aged ≥65 years (2,621; 36%). Almost all heat-related deaths occurred during May–September (6,821; 94%), with the highest numbers reported during July (2,825; 39%) and August (1,925; 27%).[§]

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[§] Additional analyses are available at www.ephtracking.cdc.gov/showhome.action.

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Editorial Note

EHEs, defined as summer temperatures substantially hotter or more humid than the norm for the location and time of year, lead to increased numbers of heat-related illnesses and deaths. The number of heat-related deaths reported during the 2012 EHE, which coincided with widespread power outages, was higher than the average number of heat-related deaths reported in these four states in the same 2-week period for previous years. Of the 32 persons who died, half were aged ≥65 years. Based on medical examiner reports, lack of air conditioning and the type of housing contributed to some of these deaths.

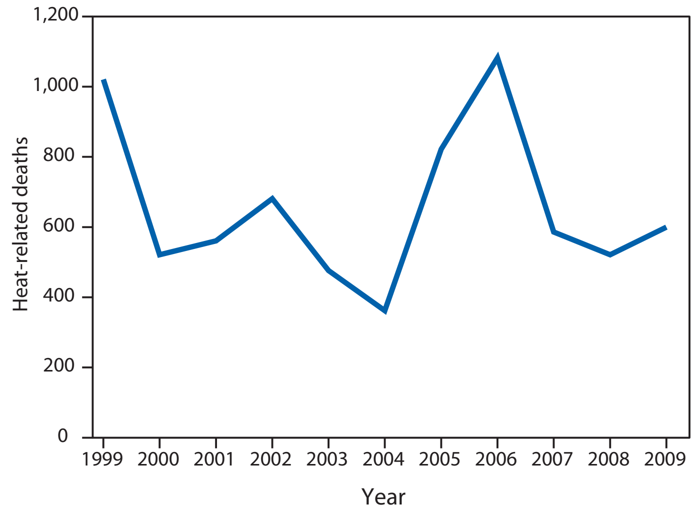
Heat-related deaths are preventable, and advanced planning for EHEs is recommended to minimize mortality during these events (*6,7*). Identifying vulnerable populations (e.g., the elderly, very young persons, persons with chronic illnesses, or those with altered mental status) and targeting interventions to those most at risk are keys to prevention. Interventions during an EHE include staying cool, hydrated, and informed about extreme heat alerts in the area and symptoms of heat illness.

Several states developed interventions targeting the elderly during the 2012 EHE. In Ohio, the Emergency Management Agency, the Department of Health, and the Department of Aging collaborated to identify areas of high concentrations of power outages and high populations of older residents. Beginning July 1, approximately 200 National Guard personnel conducted home visits to the elderly to identify persons experiencing signs of heat exhaustion using wellness toolkits prepared by these three organizations. On July 2, Ohio launched a "Check on Your Neighbor" campaign to encourage residents to help identify and assist persons at risk. On July 3, the Ohio Board of Regents and Department of Aging enlisted the aid of university and college students as part of the "Knock and Talk" effort targeting the elderly. The National Guard in West Virginia also participated in home visits to the elderly and other socially isolated persons, with approximately 100 health and wellness teams going door-to-door in communities throughout the state. In Maryland, assisted-living programs servicing ≥50 persons are required to have an emergency electrical power generator onsite.[¶]

Utility companies in Virginia and West Virginia were represented in the emergency operations centers from the onset of the EHE and worked with the states to prioritize power restoration to vulnerable populations. States also used multiple media formats (e.g., press releases, media interviews, social media, reverse 911 calls, and daily web updates) to communicate rapidly and frequently with the public and provide educational messages and increased awareness of resources.

¶ Emergency electrical power generator. Maryland Code Health–General, Title 19, Subtitle 18, Sect. 19-1812 (2010).

FIGURE. Heat-related deaths — United States, 1999–2009



Source: National Vital Statistics System. Mortality public use data files, 1999–2009. Available at http://www.cdc.gov/nchs/data_access/vitalstatsonline.htm.

In Virginia, pre-scripted public information messages about the dangers of excessive heat exposure and available resources are prepared before summer begins. Developing communication plans before an event allows for a quicker response (*8*), and enables staff to focus on other intervention activities.**

Municipalities can develop heat response plans in preparation for EHEs. In 2011, the Maryland Department of Health and Mental Hygiene developed a heat emergency plan that outlines actions to be taken before the beginning of the extreme heat season and provides guidance during an EHE. Under this plan, educational messages regarding heat exposure risks are issued beginning in June. Although the combination of widespread power outages and high temperatures was unexpected, public awareness in Maryland of the risks associated with excessive heat exposure likely was heightened as a result of educational messages.[††]

In the 2012 EHE, 69% of decedents were found at home without air conditioning. Five decedents had an air conditioner that was not turned on. Power loss might have contributed to these deaths; decedents might have been unaware that power had been restored before they succumbed to heat. To increase access to air conditioning, cooling stations or other public locations could be opened to provide residents temporary relief

** A media toolkit for extreme heat, including resources targeted at specific groups, is available at http://www.cdc.gov/nceh/extremeheat.

†† Sample educational materials are available at http://www.cdc.gov/nceh/extremeheat/materials.html.

What is already known on this topic?

Excessive heat is a leading cause of preventable, weather-related deaths, particularly among the elderly. Recommended interventions for individuals include staying cool, hydrated, and informed.

What is added by this report?

During June 30–July 13, 2012, a total of 32 persons died from excessive heat exposure in four states. Their median age was 65 years (range: 28–89 years); 72% were male, and 75% were unmarried or living alone. Overall, 22 (69%) decedents died at home, with lack of air conditioning reported in 20 (91%) of these deaths. Despite widespread power outages, the numbers of heat-related deaths were lower than expected compared with the numbers occurring in previous extreme heat events.

What are the implications for public health practice?

Although evaluating the efficacy of heat response plans is difficult, advanced planning for extreme heat events and rapid, coordinated responses among state and local agencies and public and private entities might minimize the loss of life during a heat event and should be encouraged.

from heat, particularly when elevated temperatures occur for several consecutive days. However, qualitative studies suggest that cooling stations are not well-used because of perceived and real barriers, including lack of transportation access, safety issues, stigma of public shelters, inability to bring pets, and limited operating hours (Sabrina McCormick, PhD, George Washington University, personal communication, 2013).

The findings in this report are subject to at least four limitations. First, because only deaths in which excessive heat exposure was recorded on the death certificate were reported, the number of deaths in which heat was a contributing factor might be underestimated (*7*). Second, although the 14-day reporting period was chosen on the basis of surveillance data, maximum daily temperatures, and time to power restoration, some deaths caused by this event might have occurred after July 13. Third, because historical numbers were based on codes assigned by the National Vital Statistics System (NVSS) and deaths reported in the 2012 EHE were based on death certificates, discrepancies might have occurred in how deaths were classified. Finally, because a few heat-related deaths occur each year in these four states, some of the deaths captured might have been part of the background rate and not a result of loss of power during the EHE. The number of deaths that might have occurred in these states regardless of the 2012 EHE could not be quantified because the historical numbers varied from year to year.

The targeted interventions for vulnerable populations that were implemented by the affected states might have reduced the loss of life from this EHE. Interventions, including rapid distribution of public health messages (e.g., reverse 911 calls), visits to persons at high risk, and laws to provide additional resources, (e.g., back-up power supplies to vulnerable populations), might have contributed to lower numbers of heat-related deaths. Public health and emergency management personnel should work together to identify vulnerable populations in their area and design response plans to guide actions during an EHE.

Acknowledgments

Timothy Powell, Virginia Dept of Health. Joseph Annelli, Maryland Dept of Health and Mental Hygiene. West Virginia Health Statistics Center.

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UNITED STATES DISTRICT COURT
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Plaintiffs' Consolidated Summary Judgment Response Appendix

EXHIBIT 125

bly also MDR HIV. The findings in this report, along with increasing syphilis rates, continuing gonorrhea transmission, and the emergence of lymphogranuloma venereum in HIV-positive MSM, reflects a resurgence of unsafe sex among MSM. This behavior also has been associated with increasing use of methamphetamine (*7*).

The genotype data collected by NYCDOH indicated a low prevalence of MDR genotypes among persons who had not been treated with ARVs and who had HIV infections diagnosed during June 1, 2004–June 30, 2005. Drug-resistant HIV compromises the effectiveness of standard ARV regimens and can limit the treatment options available to persons with newly diagnosed HIV infection (*6*). Therefore, CDC has provided funding to four city and 17 state health departments to conduct drug-resistance surveillance on remnant sera obtained from all patients with newly diagnosed HIV infection (*8*). Provisional data from these areas indicate that as many as 15% of these patients are infected with an HIV strain that has mutations associated with resistance to ARVs, and 3.2% have mutations associated with resistance to two or more classes of such medications.[§]

Case reports such as the one described here and results from surveillance of newly diagnosed, drug-resistant HIV infections contributed to recent changes in HIV-1 treatment guidelines issued by the U.S. Department of Health and Human Services (*9*). These guidelines now recommend performing drug-resistance testing before initiation of therapy in patients who have never received ARV treatment. To reduce HIV-associated morbidity and mortality in the United States, public health officials should intensify measures to improve early diagnosis, partner notification, and prevention counseling for persons (particularly MSM) who are HIV positive and should conduct population-based genotype surveillance to monitor the emergence of unusual strains of HIV, particularly those with mutations associated with ARV resistance (*8,10*).

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Heat-Related Deaths — United States, 1999–2003

Heat-related illnesses (e.g., heat cramps, heat exhaustion, heat syncope, or heatstroke) can occur when high ambient temperatures overcome the body's natural ability to dissipate heat (*1*). Older adults, young children, and persons with chronic medical conditions are particularly susceptible to these illnesses and are at high risk for heat-related mortality (*2*). Previous analyses of the risk factors associated with heat-related deaths* have been based on the underlying cause[†] entered on the death certificate (*4,5*) and have not included decedents for whom hyperthermia was listed as a contributing factor but not the underlying cause of death. This report describes an analysis in which number of heat-related deaths were counted, including deaths in which hyperthermia was listed as a contributing factor on the death certificate. The analysis revealed that including these deaths increased the number of heat-related deaths by 54% and suggested that the number of heat-related deaths is underestimated.

CDC uses information from death certificates categorized by codes from the *International Classification of Diseases* to estimate national mortality trends. These data, collected and submitted by states, were used to determine the number of deaths in the United States during 1999–2003 that had expo-

* Defined as a death in which exposure to high ambient temperatures either caused the death or contributed to it substantially, the decedent had a body temperature at the time of collapse >105°F (>40.6°C), the decedent had a history of exposure to high ambient temperature, and other causes of hyperthermia could reasonably be excluded (*3*).

[†] The underlying cause of death is defined as the disease or injury that initiated the chain of events that lead directly and inevitably to death. Contributing conditions, or factors, are defined as diseases, injuries, or complications that directly caused the death. A sample death certificate, showing underlying and contributing causes of death, is available at http://www.cdc.gov/nchs/data/dvs/death11-03final-acc.pdf.

sure to excessive natural heat[§] recorded as the underlying cause (code X30 from ICD, tenth revision [ICD-10]), hyperthermia[¶] recorded as a contributing factor (ICD-10 code T67) (*6*), or both.

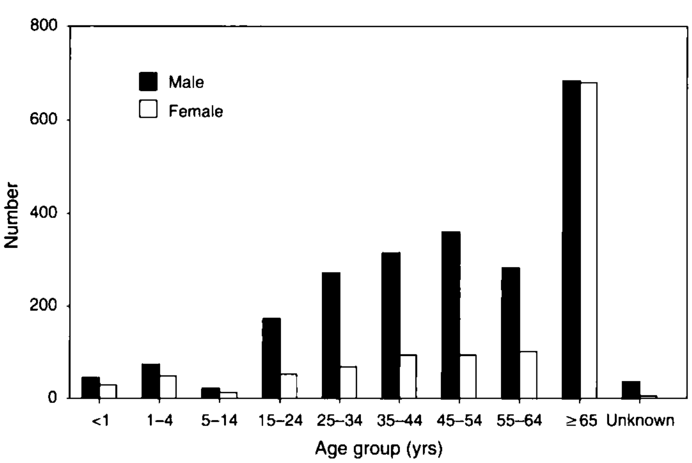
During 1999–2003, a total of 3,442 deaths resulting from exposure to extreme heat were reported (annual mean: 688). For 2,239 (65%) of these deaths, the underlying cause of death was recorded as exposure to excessive heat; for the remaining 1,203 (35%), hyperthermia was recorded as a contributing factor. Deaths among males accounted for 66% of deaths and outnumbered deaths among females in all age groups (Figure). Of the 3,401 decedents for whom age information was available, 228 (7%) were aged <15 years, 1,810 (53%) were aged 15–64 years, and 1,363 (40%) were aged ≥65 years. The state with the highest average annual hyperthermia-related death rate during 1999–2003 was Arizona (1.7 deaths per 100,000 population), followed by Nevada (0.8) and Missouri (0.6).

Cardiovascular disease was recorded as the underlying cause of death in 681 (57%) of cases in which hyperthermia was a contributing factor (Table). Approximately 70% of these heat-related cardiovascular deaths occurred among persons with reported chronic ischemic heart disease. External causes (e.g., unintentional poisonings) were documented as the underlying cause of 345 (29%) deaths in which hyperthermia was a contributing factor. Endocrine, nutritional, and metabolic disorders (e.g., diabetes mellitus) were the underlying causes in 38 (3%) of total deaths. All other underlying causes, including infection and psychiatric disorders, accounted for 139 (11%) deaths.

[§] Heat-related deaths can also be caused by exposure to excessive heat of man-made origin (e.g., from saunas or furnace malfunctions; *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* [ICD-10] code W92) and can include homicides and suicides involving exposure to excessive heat. Deaths from these causes were not included in this analysis.

[¶] Abnormally high body temperature caused by the body's inability to dissipate heat.

FIGURE. Number of heat-related deaths,* by sex and age group — United States, 1999–2003



* Exposure to extreme heat is reported as the underlying cause of or a contributing factor to death (N = 3,442).

TABLE. Selected underlying causes of death with hyperthermia* as a contributing factor† — United States, 1999–2003

Underlying cause of death	No.	(%)
Cardiovascular diseases	**681**	**(56.6)**
Chronic ischemic heart disease	473	(39.3)
Acute ischemic heart disease	63	(5.2)
Hypertensive heart disease without congestive heart failure	60	(5.0)
Other cardiovascular diseases	85	(7.1)
External causes of morbidity and mortality	**345**	**(28.7)**
Accidental poisoning by and exposure to noxious substances	51	(4.2)
Assault	63	(5.2)
Other external causes of morbidity and mortality	231	(19.2)
Diseases of the respiratory system	**37**	**(3.1)**
Chronic obstructive pulmonary disease, unspecified	27	(2.2)
Other diseases of the respiratory system	10	(0.8)
Endocrine, nutritional, and metabolic disorders	**38**	**(3.2)**
Unspecified diabetes mellitus	26	(2.2)
Other endocrine, nutritional, and metabolic disorders	12	(1.0)
Mental and behavioral disorders	**29**	**(2.4)**
Mental and behavioral disorders due to alcoholism	21	(1.7)
Other mental and behavioral disorders	8	(0.7)
Diseases of the digestive system	**22**	**(1.8)**
Fibrosis and cirrhosis of the liver	15	(1.2)
Other diseases of the digestive system	7	(0.6)
Other diseases of the nervous, infectious, immune, and genitourinary systems and neoplasms	**51**	**(4.2)**

* Abnormally high body temperature caused by the body's inability to dissipate heat.
† N = 1,203.

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Editorial Note: In this analysis, the inclusion of hyperthermia as a contributing cause of death increased by 54% the total number of heat-related deaths during 1999–2003 that would have been counted through inclusion of a heat-related underlying cause alone. Because heat-related illnesses can exacerbate existing medical conditions and death from heat exposure can be preceded by various symptoms, heat-related deaths can be difficult to identify when illness onset or death is not witnessed by a clinician. In addition, the criteria used to determine heat-related causes of death vary among states. This can lead to underreporting heat-related deaths or to reporting heat as a factor contributing to death rather than the underlying cause (*3*). The demographics (e.g., sex, age group, and state) of the decedents described in this report are

consistent with previous descriptions of persons at risk for heat-related deaths (*4,5*).

This analysis also provides additional information on the underlying causes of death in which hyperthermia was a contributing factor. Although this report might still underestimate the extent of overall heat-related morbidity and mortality, the inclusion of hyperthermia as a contributing factor to death provides a more comprehensive view of the actual effects of heat-related illnesses. The association between cardiovascular disease and heat-related death is well established (*7*); this analysis suggests the need for additional investigations of the association between noncardiovascular conditions, such as endocrine and respiratory diseases, and the risk for heat-related death.

Continued exposure to excessive heat can lead to hyperthermia or death. Of the heat-related illnesses, heat exhaustion and heatstroke are the most serious. Heat exhaustion is characterized by muscle cramps, fatigue, headache, nausea or vomiting, and dizziness or fainting. The skin is often cool and moist, indicating that the body's mechanism for cooling itself (i.e., sweating) is still functioning. The pulse rate is typically fast and weak, and breathing is rapid and shallow. If untreated, heat exhaustion can progress to heatstroke (*1*). Heatstroke is a serious, life-threatening condition characterized by a high body temperature (>103°F [>39.4°C]); red, hot, and dry skin (no sweating); rapid, strong pulse; throbbing headache; dizziness; nausea; confusion; and unconsciousness. Symptoms can progress to encephalopathy, liver and kidney failure, coagulopathy, and multiple organ system dysfunction (*2*). Prompt treatment of heat-related illnesses with aggressive fluid replacement and cooling of core body temperature is critical to reducing morbidity and mortality (*2*).

Many heat-related deaths, regardless of whether they are associated with chronic medical conditions, are preventable. During periods of extreme heat, heat-related illnesses can be prevented by avoiding strenuous outdoor activities, drinking adequate amounts of fluid, avoiding alcohol consumption, wearing lightweight clothing, and using air-conditioning. Groups at high risk include young children, persons aged >65 years, persons who do strenuous activities outdoors, and persons with chronic (particularly cardiovascular) medical conditions (*8*).

During heat waves, young children, older adults, and chronically ill persons should be checked frequently by relatives, neighbors, and caretakers to evaluate their heat exposure, recognize symptoms of heat-related illness, and take appropriate preventive action. Regardless of the outdoor temperature, parents and other child-care providers should never leave children alone in cars and should ensure that children cannot lock themselves inside enclosed spaces, such as the trunks of automobiles.

Communities can prepare for heat-related illnesses by creating well-defined heat response plans (HRPs) (*9*). Both governmental and nongovernmental organizations, each with specific roles and responsibilities, can be involved in this planning. HRP protocols and communication tools should be reviewed annually, before the summer months begin. The HRPs should identify populations at high risk for heat-related illness and death and determine which strategies will be used to reach them during heat emergencies. The HRP should also include specific criteria for activation and deactivation of the plan. Postemergency evaluations of HRPs are necessary to make appropriate revisions and improve plan effectiveness.

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Chagas Disease After Organ Transplantation — Los Angeles, California, 2006

Chagas disease is an infection caused by the parasite *Trypanosoma cruzi*. Reduviids (i.e., "kissing bugs") transmit the parasite through infected feces. *T. cruzi* also can be transmitted congenitally and through blood transfusion or organ transplantation. The infection is lifelong if left untreated; the majority of infected persons are asymptomatic, and their disease remains undiagnosed. Although routine serologic testing of organ and blood donors is performed in areas of Latin

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

STEPHEN McCOLLUM, and SANDRA McCOLLUM, individually, and STEPHANIE KINGREY, individually and as independent administrator of the Estate of LARRY GENE McCOLLUM, PLAINTIFFS	§ § § § § § §	
v.	§ § §	CIVIL ACTION NO. 4:14-cv-3253 JURY DEMAND
BRAD LIVINGSTON, JEFF PRINGLE, RICHARD CLARK, KAREN TATE, SANDREA SANDERS, ROBERT EASON, the UNIVERSITY OF TEXAS MEDICAL BRANCH and the TEXAS DEPARTMENT OF CRIMINAL JUSTICE. DEFENDANTS	§ § § § § § §	

Plaintiffs' Consolidated Summary Judgment Response Appendix

EXHIBIT 126

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™

Morbidity and Mortality Weekly Report (*MMWR*)

Heat Stress Illness Hospitalizations — Environmental Public Health Tracking Program, 20 States, 2001–2010

Surveillance Summaries

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Abstract

Problem/Condition: Heat stress illness (HSI), also known as heat-related illness, comprises mild heat edema, heat syncope, heat cramps, heat exhaustion (the most common type of HSI), and heat stroke (the most severe form). CDC's Environmental Public Health Tracking Program receives annual hospitalization discharge data from 23 states that are used to assess and monitor trends of HSI hospitalization over time.

Reporting Period: May–September, 2001–2010.

Description of System: The Environmental Public Health Tracking Program is a comprehensive surveillance system implemented in 25 states and one city health department. The core of the system is the Tracking Network, which collects data on environmental hazards, health effects, exposures, and population. The Tracking Network provides nationally consistent environmental and health outcome data that enable federal, state, and local public health agencies to assess trends, explore associations, and generate hypotheses using these data. For HSI surveillance, the Tracking Network uses state-based hospital discharge data.

Results: During 2001–2010, approximately 28,000 HSI hospitalizations occurred in 20 states participating in the Tracking Program. Data from three states were not included in this report because of missing data for ≥3 years. Two states joined the Tracking Program after the study period and also are not included in this report. The majority of HSI hospitalizations occurred among males and persons aged ≥65 years. The highest rates of hospitalizations were in the Midwest and the South. During this period, an overall 2%–5% increase in the rate of HSI hospitalizations occurred in all 20

states compared with the 2001 rate. The correlation between the average number of HSI hospitalizations and the average monthly maximum temperature/heat index was statistically significant (at $p<0.0001$) in all 20 states.

Interpretation: Consistent with previous studies, age and sex were identified as major risk factors for HSI hospitalizations. Certain Tracking states that experienced high temperatures during summer months showed an increase in rate of HSI hospitalizations over the 10-year study period.

Public Health Action: HSIs are preventable and an important focus of public health interventions at state and local health departments. Federal, state, and local public health agencies can use data on HSI hospitalizations for surveillance purposes to estimate trends over time and to design targeted intervention to reduce heat stress morbidity among at-risk populations.

Introduction

All persons, regardless of age, sex, or health status, are at risk for heat stress illness (HSI), also known as heat-related illness (*1*). The body's physiologic mechanisms maintain a person's core body temperature (i.e., the operating temperature of vital organs in the head or trunk) in a narrow optimal range around 98.6° F (37° C) (*1*). When a person's core body temperature rises, the body's immediate physiologic response is to sweat and circulate blood closer to the skin's surface so as to increase cooling (*2*). If heat exposure exceeds the body's physiologic capacity to cool, and if the person's core body temperature then rises, a range of heat stress symptoms and conditions can develop.

HSI ranges from mild heat cramps, heat exhaustion, and heat syncope to the most severe condition, heat stroke (*1*). HSI can manifest in multiple clinical outcomes, and persons with chronic health conditions (e.g., cardiovascular disease, diabetes, or obesity) are more susceptible to the effects of heat than persons without such conditions (*3*). For these reasons, HSI might not always be listed as the primary diagnosis in the discharge data collected by local hospitals. Despite this limitation, discharge data from local hospitals can be used to monitor the prevalence of HSI and examine heat stress morbidity (*4–6*).

Background

The relationship between extreme temperatures, increased HSI, and deaths is well established (*3,7*). Increases in the rates of HSI hospitalizations are one of the many potential impacts of extreme heat (*4,8,9*). Monitoring heat-related hospitalizations can help document changes in the burden of HSI over place and time, identify and monitor vulnerable areas, and evaluate the effectiveness of local climate-adaptation strategies.

Hospital discharge data are state-based administrative data created for hospital billing and payment purposes. Information on patient demographics, diagnoses, procedures performed, and sources of payment (including self-pay and uninsured) is collected on all patients discharged from acute-care hospitals within a state (*6*). Since approximately 1990, state hospital discharge data systems have provided information to researchers, policy makers, providers, and consumers to improve health-care cost, quality, and health-care access (*10*). As the only source of hospital use data that includes all patients and all payers from in a state, hospital discharge data support multiple community and national health information initiatives (*10*).

This report analyzes data on HSI hospitalizations from CDC's Environmental Public Health Tracking Program for 2001–2010 to summarize the incidence of HSI and examine the trend in the rate of HSI hospitalizations by age, sex, county, and state. The findings in this report can be used by federal, state, and local public health professionals for surveillance purposes to estimate trends over time and to design targeted intervention to reduce heat stress morbidity among at-risk populations.

Methods

Data Source

CDC's Environmental Public Health Tracking Program was established in 2002 and has been implemented in 25 states and one large city health department* (*11*). The core of this program is the Tracking Network, which includes information on environmental hazards, health effects, exposures, and population data that are received primarily from states and national sources. All of the Tracking Network participants develop local tracking networks, whose efforts feed into the National Tracking Network. Partnerships between federal, state, and local public and environmental health agencies have helped the Tracking Network develop and adopt nationally consistent indicators and measures. Data are presented as measures and organized by indicator for each content area. A content area might focus on health, exposure, the environment, or the intersection of health and the environment (*11*). The Tracking Network allows users to view data in maps, tables, and charts; search and view metadata; and find information about their community's health and environment (*11*).

Data Collection and Processing

The Tracking Network receives hospitalization discharge data from 25 funded states. Of these 25 states, 23 states† have a mandate to collect hospital discharge data at the state level, and two states (Michigan and Colorado) collect data voluntarily (Figure 1) (*12*). For this report, data were used from 20 states to examine trends of HSI. Data from two new Tracking Network grantee states (Michigan and Kentucky) were not included because these states received funding in October 2014, after the study period covered in this report. Data from three other states (Colorado, Maryland, and New Hampshire) were not used because ≥3 years of data were missing.

Tracking Network states submit de-identified county-level hospitalization data for HSI to the National Tracking Network annually. HSI hospitalizations are submitted as monthly aggregates for the summer months (May–September) per year to the Tracking Network. These data then are used to calculate annual state level estimates (number, crude rate, and age-adjusted rate), and these estimates are displayed in the Tracking Network's Internet web portal (available at http://ephtracking.cdc.gov/showHome.action).

Data collection begins at in-patient hospitals, which create and maintain patient transaction information. Hospitals submit hospitalization discharge data, usually quarterly, to state data stewards, which can be either public organizations (e.g., a part of the state government) or a delegated authority (e.g., a hospital association or private entity). After validating and finalizing the hospitalization discharge data, state data stewards transfer the data to state tracking programs, which submit de-identified hospitalization discharge data to the Tracking Network annually. The Tracking program has developed standardized guidelines for preparing and submitting hospitalization data that all states are required to follow. Once data are received by the Tracking Program, all

hospitalization data are processed to create nationally consistent data and measures that become available to stakeholders, including the public, via a web-based query system (*13*).

Case Definition

HSI might not always be listed as the primary diagnosis in the discharge data collected by local hospitals. For all possible cases of HSI to be captured, all cases for which the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code for HSI is listed explicitly as either the primary diagnosis or as any other diagnosis must be included. HSI hospitalization was defined as any illness requiring hospital admission (i.e., in-patient hospital stay for ≥23 hours) for which a primary or other diagnosis ICD-9-CM code in the range of 992.0–992.9 or cause-of-injury code E900.0 or E900, excluding cases with a code of E900.1 (exposure to a man-made source of heat), was recorded. All cases that met the case definition and occurred during May–September of each year during 2001–2010 were included in the analyses.

Analytic Methods

The total number of HSI cases in 20 states for the 10-year study period 2001–2010 was measured, and crude and age-adjusted rates of HSI hospitalization per 100,000 population were calculated at the state and county level. Correlations between number of monthly HSI hospitalizations and average monthly maximum temperature at the county level were examined for all 20 states. Changes in the rate of HSI hospitalizations over the 10-year study period also were examined.

Modeled meteorology data from the North American Land Data Assimilation System were processed by the Tracking Program to create indicators for use in extreme heat surveillance and research. Tracking Network users have access to county-level daily heat metrics data (e.g., daily maximum temperature and heat index) for 1979–2011. Average monthly heat metrics were generated for daily (24-hour) maximum temperature, and heat index was generated from daily data (*14*). County-level data were linked with hospitalization data to explore the relationship between hospital discharge data and temperature.

Tracking Network states provided county-level monthly aggregates for HSI cases for each year, which CDC used to calculate county- and state-level yearly totals. Crude rates of HSI per 100,000 population were calculated by using midyear resident population from the U.S. Census Bureau (*15,16*); annual age-adjusted rates were calculated by the direct method using the 2000 U.S. Standard Population, divided into 18 age groups (*17*). The 10-year average crude rate per 100,000 population was calculated by using the 10-year average number of HSI hospitalizations as the numerator and the 10-year average population as the denominator from 20 states. Spearman rank correlation was used to examine the correlation between monthly number of HSI cases, the average monthly maximum temperature, and the average monthly heat index; statistical significance was determined as $p<0.05$. Poisson log-linear regression analyses were used to examine the trend of heat stress rates over time, with 2001 data used as the baseline.

The incident rate ratio (IRR) of HSI hospitalizations over time was calculated. Rates and IRRs were calculated with a 95% confidence interval; statistical significance was determined as $p<0.05$. The expected count of HSI hospitalizations (z) per year (t) in a state (s) was modeled as follows:

$$E(z_t) = P_t \times e^{(\alpha + \beta t)}$$

where *P*t is the population of the state in year t and *z*t is the number of HSI hospitalizations. All analyses were performed by using SAS version 9.3, and maps were created by using ESRI ArcGIS version 10.1.

Results

Demographics

During 2001–2010, a total of 28,133 HSI hospitalizations were reported in 20 Tracking Network states (Table 1). A majority of the cases were in males (69.2%) and a plurality were in persons aged ≥65 years (42.3%). During the study period, the highest number of HSI hospitalizations (n = 4,022) was reported in 2006, and the lowest number (n = 1,737) was reported in 2004. Similarly, the highest crude and age-adjusted rates per 100,000 population per year (crude rate: 2.7; age-adjusted rate: 2.5) were observed in 2006, and the lowest rates (crude rate: 1.7; age-adjusted rate: 1.1) were observed in 2004.

Rate of HSI Hospitalizations

Among the 20 Tracking Network states over the 10-year period, the highest number of HSI cases (n = 5,385) was reported in California, and the lowest number of cases (n = 37) was reported in Vermont. The crude and age-adjusted rate of HSI hospitalizations per 100,000 population in 20 Tracking Network states from 2001 to 2010 are reported (Tables 2 and 3). Five states (Florida, Louisiana, Kansas, Missouri, and South Carolina) had the highest crude and age-adjusted rate of HSI per 100,000 population per year for all 10 study years (Figures 2 and 3).

The 10-year average crude rate of HSI hospitalizations at the county level in 20 Tracking Network states is reported (Figure 4). The five counties with the highest 10-year average crude rate of HSI hospitalizations per 100,000 population were Lane County, Kansas (32.2); Gove County, Kansas (31.8); Pemiscot County, Missouri (28.3); Clark County, Kansas (26.2); and Madison County, Louisiana (24.5). The 10-year average age-adjusted rate of HSI hospitalizations at the county level is reported for 20 Tracking Network states (Figure 5). Similar to the crude rate, the five counties with the highest 10-year average age-adjusted rate of HSI hospitalizations per 100,000 population were Gove County, Kansas (33.8); Pemiscot County, Missouri (27.9); Madison County, Louisiana (25.1); Lane County, Kansas (24.9); and Morton County, Kansas (20.4).

Trend Analysis

Trend analysis using Poisson regression showed statistically significant ($p<0.05$) changes in the rate of HSI hospitalizations in 13 states (Table 4). In eight states (California, Connecticut, Florida, Louisiana, Missouri, New Mexico, South Carolina, and Washington), the increase in the rate of hospitalization ranged from 2% to 6% over the 10-year period, using the 2001 rate as the baseline. Kansas was among the five states with the highest crude and age-adjusted rates of HSI hospitalization, but a statistically significant increase in the rate of HSI hospitalizations over the 10-year period was not observed ($p<0.05$). Alternatively, a decrease (range: 5%–12%) was observed in the rate of heat stress hospitalizations in five states (Iowa, Maine, Massachusetts, New York, and Wisconsin) (Table 4).

Correlation Between Temperature and Heat Stress Illness

The correlation between the 10-year monthly average number of HSI hospitalizations at the state level and the 10-year monthly average maximum temperature at the county level was examined in 20 Tracking Network states (Table 5). In all 20 states, a statistically significant correlation was observed between monthly average number of HSI hospitalizations and average monthly maximum temperature. The strongest correlation was observed in Massachusetts ($\rho[700] = 0.54$; $p<0.0001$) and the weakest correlation was seen in Florida ($\rho[3350] = 0.07$, $p<0.0001$). The six northeastern states showed the strongest correlation between monthly average number of HSI hospitalizations and average monthly maximum temperature: Massachusetts ($\rho[700] = 0.54$; $p<0.0001$), New Jersey ($\rho[1050] = 0.49$; $p<0.0001$), Connecticut ($\rho[400] = 0.44$; $p<0.0001$), New York ($\rho[3100] = 0.41$; $p<0.0001$), and Pennsylvania ($\rho[3350] = 0.39$; $p<0.0001$). Similarly, a correlation was observed between the monthly average number of HSI hospitalizations and the monthly average heat index (Table 6). The strongest correlation was seen in Massachusetts ($\rho[700] = 0.55$; $p<0.0001$), and the lowest correlation was observed in Vermont ($\rho[700] = 0.17$; $p<0.0001$). The Northeastern states showed the strongest correlation between the average number of HSI hospitalizations and the monthly average heat index: Massachusetts ($\rho[700] = 0.55$; $p<0.0001$), New Jersey ($\rho[1050] = 0.52$; $p<0.0001$), Connecticut ($\rho[400] = 0.46$; $p<0.0001$), New York ($\rho[3100] = 0.42$; $p<0.0001$) and Pennsylvania ($\rho[3350] = 0.41$; $p<0.0001$).

Discussion

HSIs are generally preventable and are an important focus for public health interventions at state and local health agencies. The findings in this report indicate that Tracking Network states in the South and the Midwest had the highest rate of HSI over the 10-year period. A small increase was observed in the rate of HSI hospitalizations in a majority of the Tracking Network states, but a slight decrease occurred in others (mainly in the northern states). For states in the Northeast, a relatively strong positive correlation was found between the number of HSI hospitalizations and the average monthly maximum temperature/heat index.

Previous studies have identified sex as a risk factor for HSI. Men are more likely than women to work outdoors and seek medical help for HSI (*3,7*). Consistent with these studies, the findings in this report demonstrate that approximately 70% of the HSI cases occurred among males. Similarly, rates of HSI hospitalization over the 10-year period were also higher among males. Similar findings were reported in studies that focused on occupational and recreational heat exposures (*3,18,19*).

Previous studies also have identified age as a risk factor for HSI (*4,5,7,9,20*). The findings in this report indicate that the majority (83.1%) of HSI hospitalizations occurred among persons aged ≥35 years, and especially among persons aged ≥65 years (approximately 43.0%). Data recorded during a 2006 California heat wave also indicated that 52% of the excess number of HSI hospitalizations that occurred during heat waves were among persons aged ≥65 years (*4*). Another study conducted in Australia found that 39% of HSI hospitalization occurred among persons aged ≥65 years (*9*). The findings in this report also identified persons aged ≥65 years as being at higher risk for HSI than persons aged <65 years.

Midwestern and Southern states usually experience higher temperatures in summer months compared with Northern states. Exposure to extreme temperatures has been associated with both

mortality and morbidity (*21*). Hospital discharge data and temperature data in 20 Tracking Network states showed that the highest numbers of HSI hospitalizations occurred in the Midwestern and Southern states. The highest rate of HSI hospitalizations and an increasing trend in hospitalizations also were observed in these states. Similarly, the counties with highest rates of HSI hospitalizations were also in the Midwestern and Southern states. Among the 20 Tracking Network states, the number and rates of HSI were highest in Missouri. An increase in HSI hospitalization trend also was observed in Missouri over the 10-year study period. Missouri is the only state in which HSI that is diagnosed by a physician is a reportable disease,§ which possibly contributed to increased reporting of HSI hospitalizations in the state (*22,23*).

Temperature data from the National Oceanic and Atmospheric Administration's National Climatic Data Center indicate that in all 50 states, average monthly temperatures in the summer months (May–September) during 2001–2010 were higher compared with the same months during 1981–2000 (*8,24,25,26*). Most states experienced very high temperatures in 2006 and 2007 (*23*). The findings in this report indicate that the rate of HSI hospitalizations in 20 Tracking Network states was highest in 2006. A previous study reported the impact of the 2006 heat wave on HSI hospitalizations and emergency department visits in California (*4*). Poisson regression analysis confirms that an annual increase in the rate of HSI hospitalizations occurred. The increasing trend of HSI hospitalizations during 2001–2010 and the association with temperature data show the effects of increased monthly temperatures over time. Previous studies have observed similar trends in heat-related mortality and morbidity (*3,7,25,26*).

The findings provided in this report demonstrate that a substantial number of heat stress hospitalizations occurred in the Midwest and the South. Moreover, a strong correlation was observed between temperature and an increase in the number of hospitalizations in the Northeast. Persons in places with high temperatures might adapt to high temperatures and also might limit their exposure to higher temperatures (*3,5,21*). Unlike states in the Midwest and the South, the Northeast does not experience persistent high temperatures, and the populations in these states therefore might be less acclimatized to the high temperatures that can result in HSI and subsequent hospitalizations.

Limitations

The findings provided in this report are subject to at least seven limitations. First, periods of extreme heat frequently are associated with increases in hospital visits and admissions for many causes. Data collected by the Tracking Network might not capture the full spectrum of heat stress, especially if exposure to excess heat is not documented explicitly in the patient records. Second, hospitalization data include transfers between hospitals for the same person for the same heat stress event. Therefore, variations in the percentage of transfers or re-admissions for the same heat stress event might vary by geographical area and impact rates. Third, some of the Tracking states do not have reciprocal reporting agreements with neighboring states; therefore, statewide measures and measures for geographic areas (e.g., counties) bordering other states might be underestimated because of health care use patterns. Fourth, hospitalization data collected by Tracking Network states excludes data from Veterans Affairs Medical Centers, Indian Health Services, and institutionalized (e.g., prison) populations, which might result in some underreporting of HSI hospitalizations. Fifth, variations in medical practice patterns and payment mechanisms at the state level might affect diagnostic coding and treatment decisions by health-care providers to hospitalized patients. Sixth, in addition, patients

might be exposed to environmental triggers in multiple locations, but hospital discharge geographic information is limited to residence. Finally, because the data capture hospital discharges (rather than admissions), and because cases are identified on the basis of the date of admission, patients admitted toward the end of the year and discharged the following year will be omitted from the current year data set. Also, a very small number of cases at the county level might result in an unstable rate at the county and state levels.

Conclusion

Increases in summer temperatures are associated with an increase in HSI (*4*,*25*,*27*). A comparison of HSI hospitalizations at the state and county level indicates that the Midwestern and Southern states had the highest number of HSI hospitalizations; however, a strong correlation between temperature and HSI hospitalizations also was observed in the Northeastern states. State and local health departments are interested in preventing health impacts associated with extreme heat, especially among vulnerable populations (*27*,*28*).

To gauge the public health burden to extreme heat, researchers need to understand the extent of HSI exposure and identify risk factors. HSI hospitalization surveillance provides an important measure of heat stress surveillance. In addition, state and local health departments may find it beneficial to track heat stress morbidity over time to understand and evaluate the impact of public health interventions. This study highlights the use of hospital discharge data, an existing data source in most states, for HSI surveillance. Federal, state, and local health department can utilize this invaluable data source to examine burden of HSI during summer months.

HSIs are preventable by avoiding exposure to high temperatures. State and local health agencies can work collaboratively to inform the general population about extreme weather conditions in advance (*11*). They can increase awareness on how persons can limit their exposure to extreme temperatures and information on any resources available to the public. State health departments could open cooling centers or encourage use of public facilities with air conditioning to mitigate extreme heat exposure. For example, one of the Tracking Network states used the hospitalizations and emergency department visits data along with temperature data to show the burden of HSI. On the basis of this evidence, local public health professionals and decision-makers decided to open cooling centers as part of the local heat alert response. This example indicates how surveillance for heat stress illness can help identify local patterns of vulnerability to best target an at-risk population, devise public health interventions, and implement emergency response activities.

Acknowledgments

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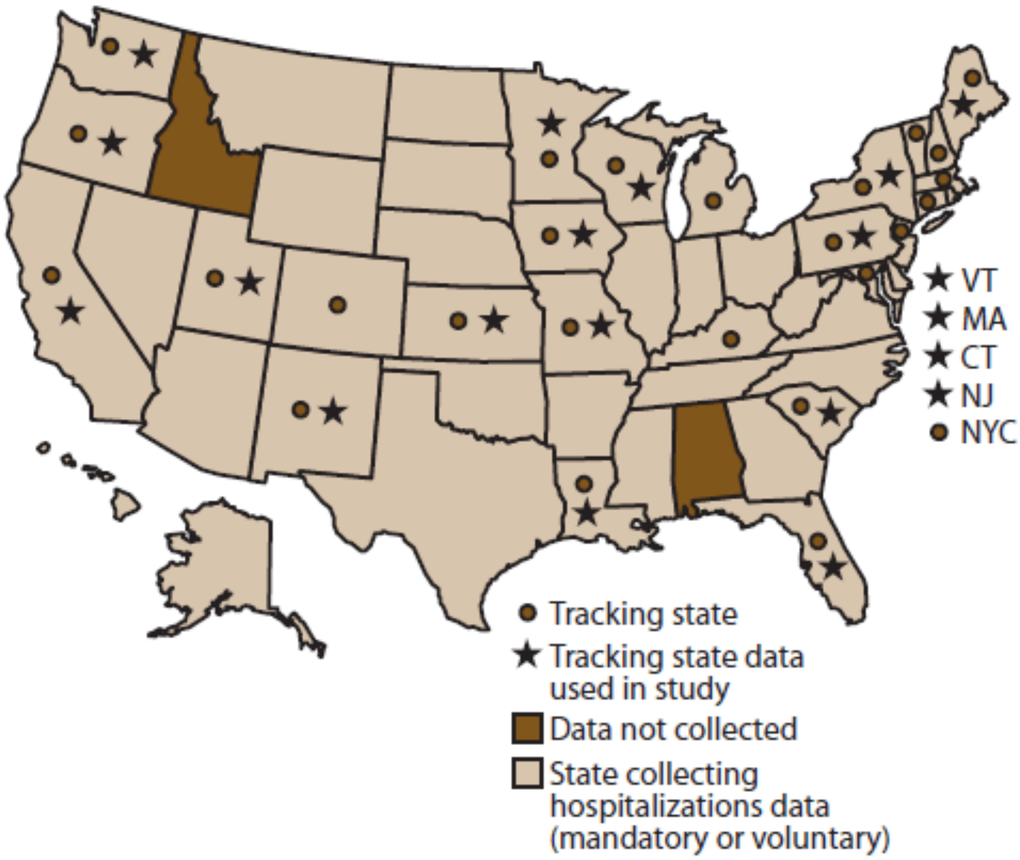
* California, Colorado, Connecticut, Florida, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York City, New York, Oregon, Pennsylvania, South Carolina, Utah, Vermont, Washington, and Wisconsin.

† California, Connecticut, Florida, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York (includes New York City), Oregon, Pennsylvania, South Carolina, Utah, Vermont, Washington, and Wisconsin.

§ Rules of Department of Health and Senior Services Division 20—Division of Community and Public Health Chapter 20—Communicable Diseases (2008).

FIGURE 1. Hospitalization discharge data collection status — United States, 2008



Source: Love D, Rudolph B, Shah GH. Lessons learned in using hospital discharge data for state and national public health surveillance: implications for Centers for Disease Control and Prevention tracking program. J Public Health Manag Pract 2008;14:533–42.

Alternate Text: The figure shows a map of the United States indicating which states that participate in the Environmental Public Health Tracking Program collect hospitalization discharge data.

TABLE 1. Number, percentage, and rate per 100,000 population of heat stress illness hospitalizations — Environmental Public Health Tracking Network, 20 states, 2001–2010

Variable	No.*	(%)	Rate†	
			Crude	Age-adjusted
Sex				
Male	19,457	(69.2)	2.6	
Female	8,676	(30.8)	1.1	
Age group (yrs)				

0–4	285	(1.0)	0.2	
5–14	389	(1.4)	0.2	
15–34	4,070	(14.5)	0.9	
35–64	11,486	(40.9)	1.8	
≥65	11,889	(42.3)	5.7	
Year				
2001	2,720	(9.7)	1.9	1.8
2002	2,817	(10.0)	1.9	1.9
2003	2,255	(8.0)	1.5	1.5
2004	1,737	(6.2)	1.2	1.1
2005	3,187	(11.3)	2.1	2.0
2006	4,022	(14.3)	2.6	2.5
2007	2,739	(9.7)	1.8	1.7
2008	2,510	(8.9)	1.6	1.5
2009	2,355	(8.3)	1.5	1.4
2010	3,791	(13.5)	2.4	2.3
Total	**28,133**		**1.9**	

* All values might not add up to the total due to missing values.

† Denominator data: US Census Bureau midyear resident population (*15,16*).

TABLE 2. Crude rate of heat stress illness hospitalizations per 100,000 population* — Environmental Public Health Tracking Network, 20 states, 2001–2010

State	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
California	1.0	1.1	1.5	1.0	1.4	3.1	1.6	1.6	1.4	1.3
Connecticut	1.3	1.4	0.9	0.5	1.3	1.5	1.2	1.3	0.6	2.4

Florida	1.5	1.8	1.7	2.0	2.9	2.4	2.9	2.2	3.0	4.2
Iowa	3.2	1.7	1.6	0.6	2.0	2.4	2.0	1.0	1.0	1.8
Kansas	5.7	3.2	3.8	2.1	3.9	5.1	2.9	2.7	3.6	4.3
Louisiana	3.1	3.8	2.5	3.8	5.8	3.9	3.7	3.0	4.2	4.8
Maine	2.4	1.9	1.3	0.8	1.6	1.1	0.9	0.5	0.3	1.4
Massachusetts	1.3	1.8	0.9	0.5	1.4	1.3	0.7	1.1	0.7	1.8
Minnesota	3.4	1.7	1.4	0.8	2.1	2.5	1.5	0.7	0.7	1.4
Missouri	4.8	4.1	3.5	2.0	4.1	6.1	4.2	2.6	3.4	6.7
New Jersey	1.5	2.1	1.2	0.7	1.6	1.8	1.0	1.3	0.7	2.2
New Mexico	0.9	1.0	0.8	0.4	1.1	0.8	1.1	1.3	1.0	1.3
New York†	1.9	2.0	1.4	0.7	1.8	2.9	1.1	1.6	0.6	2.1
Oregon	0.7	1.1	1.2	0.6	0.6	1.0	0.5	1.4	1.3	0.9
Pennsylvania	2.3	3.0	1.2	1.0	2.9	2.9	1.6	2.0	0.9	2.8
South Carolina	2.6	3.2	2.7	2.7	5.1	3.7	5.2	3.1	2.2	5.5
Utah	0.6	0.8	0.8	0.7	0.3	0.7	0.7	0.6	0.6	0.4
Vermont	1.0	1.5	0.2	0.0	0.6	0.5	0.2	1.0	0.5	0.6
Washington	0.6	0.5	0.6	0.8	0.4	1.0	0.7	0.7	1.5	0.7
Wisconsin	2.7	2.1	1.1	0.7	1.8	1.9	1.1	0.5	0.9	1.1

* Denominator data: US Census Bureau midyear resident population (*15,16*).

† Includes New York City.

TABLE 3. Age-adjusted rate of heat stress illness hospitalizations per 100,000 population* — Environmental Public Health Tracking Network, 20 states, 2001–2010

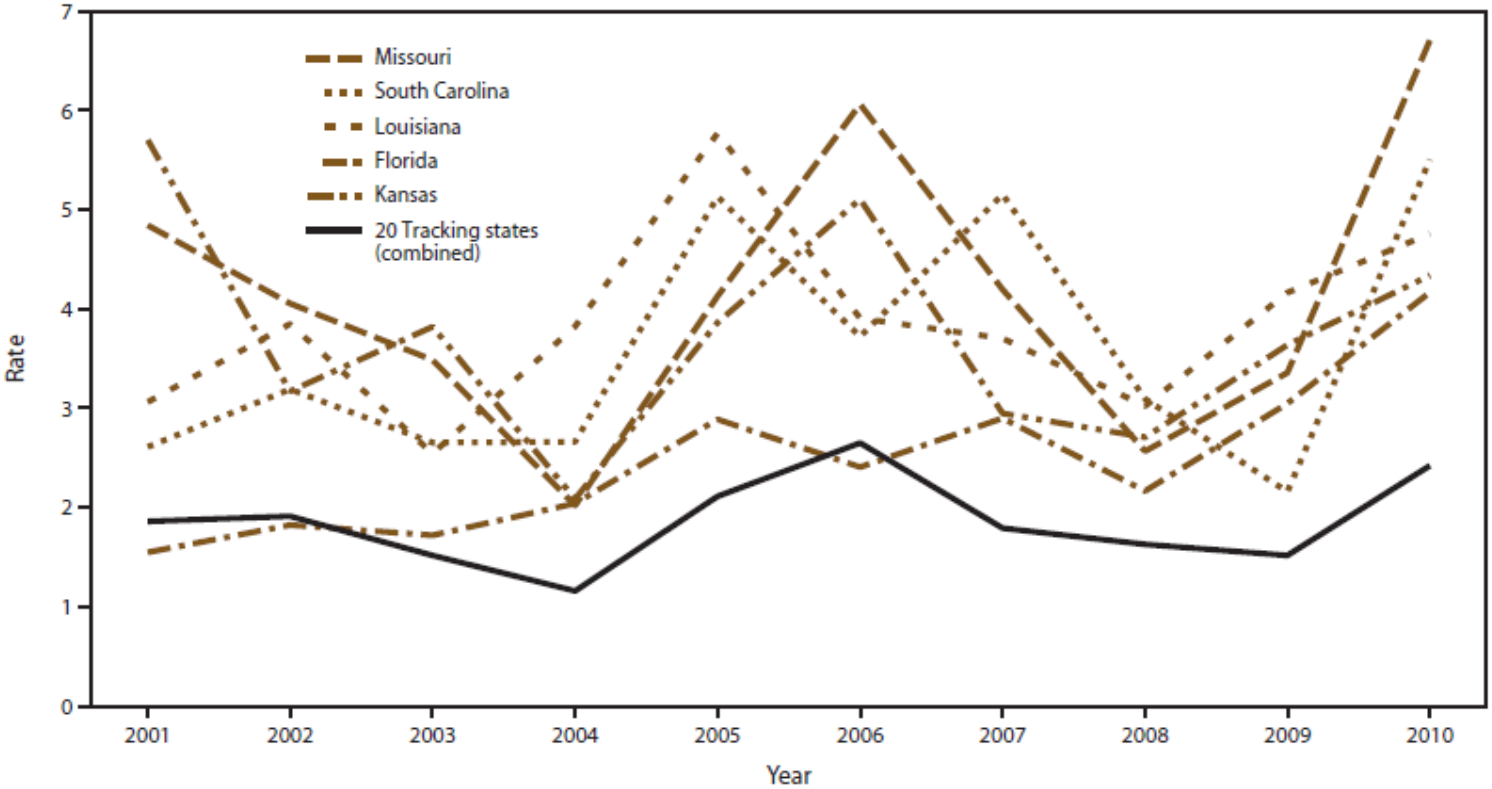
State	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
California	1.1	1.2	1.6	1.1	1.5	3.2	1.6	1.6	1.4	1.4

Connecticut	1.2	1.2	0.8	0.5	1.2	1.4	1.1	1.2	0.5	2.2
Florida	1.4	1.7	1.6	1.9	2.7	2.2	2.7	1.9	2.8	3.8
Iowa	2.9	1.6	1.5	0.6	1.7	2.0	1.8	0.9	1.0	1.6
Kansas	5.4	3.0	3.7	2.0	3.8	5.0	2.7	2.6	3.6	4.2
Louisiana	3.1	4.0	2.6	3.9	5.8	3.9	3.8	2.9	4.0	4.6
Maine	2.2	1.7	1.2	0.7	1.4	1.0	0.8	0.4	0.3	1.2
Massachusetts	1.3	1.7	0.8	0.5	1.3	1.2	0.7	1.0	0.6	1.6
Minnesota	3.4	1.7	1.4	0.8	2.1	2.4	1.5	0.7	0.7	1.4
Missouri	4.7	3.9	3.4	2.0	4.0	5.7	4.1	2.5	3.2	6.3
New Jersey	1.5	2.0	1.1	0.7	1.5	1.7	1.0	1.3	0.7	2.1
New Mexico	0.9	1.0	0.8	0.4	1.1	0.8	1.1	1.3	1.0	1.2
New York†	1.9	2.0	1.3	0.6	1.7	2.7	1.1	1.5	0.6	2.0
Oregon	0.7	1.1	1.1	0.6	0.5	0.8	0.4	1.2	1.2	0.8
Pennsylvania	2.0	2.7	1.1	0.8	2.5	2.5	1.4	1.7	0.8	2.4
South Carolina	2.6	3.2	2.6	2.6	5.1	3.6	5.0	3.0	2.1	5.2
Utah	0.8	1.0	1.0	1.0	0.3	1.0	0.9	0.6	0.6	0.5
Vermont	1.0	1.3	0.2	0.0	0.6	0.5	0.1	0.9	0.5	0.5
Washington	0.6	0.5	0.6	0.8	0.5	1.0	0.7	0.7	1.5	0.6
Wisconsin	2.6	2.0	1.1	0.6	1.7	1.8	1.1	0.4	0.8	1.0

* Denominator data: US Census Bureau midyear resident population (*15,16*).

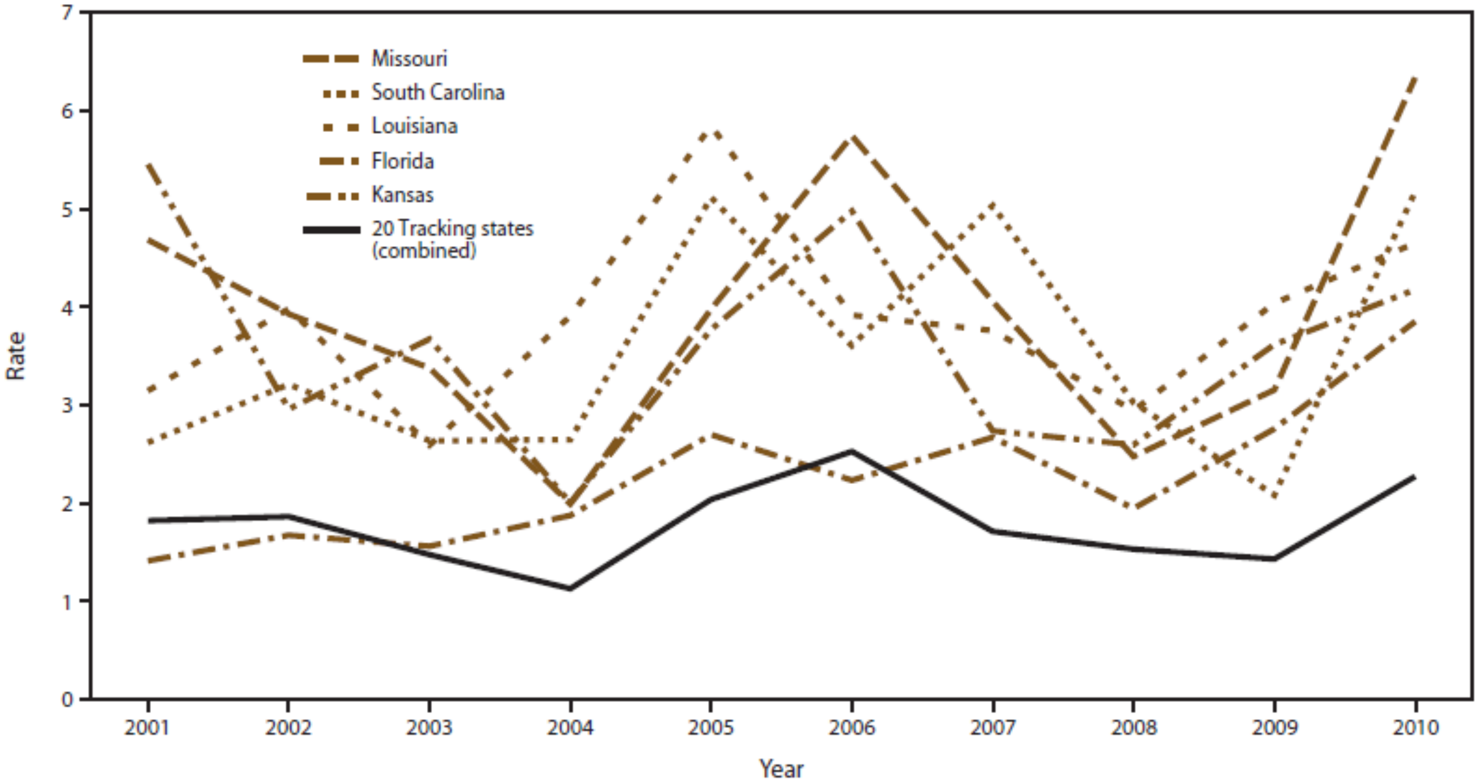
† Includes New York City.

FIGURE 2. Tracking Network states with the highest crude rate of heat stress illness hospitalizations per 100,000 population — Environmental Public Health Tracking Program, 20 states, 2001–2010



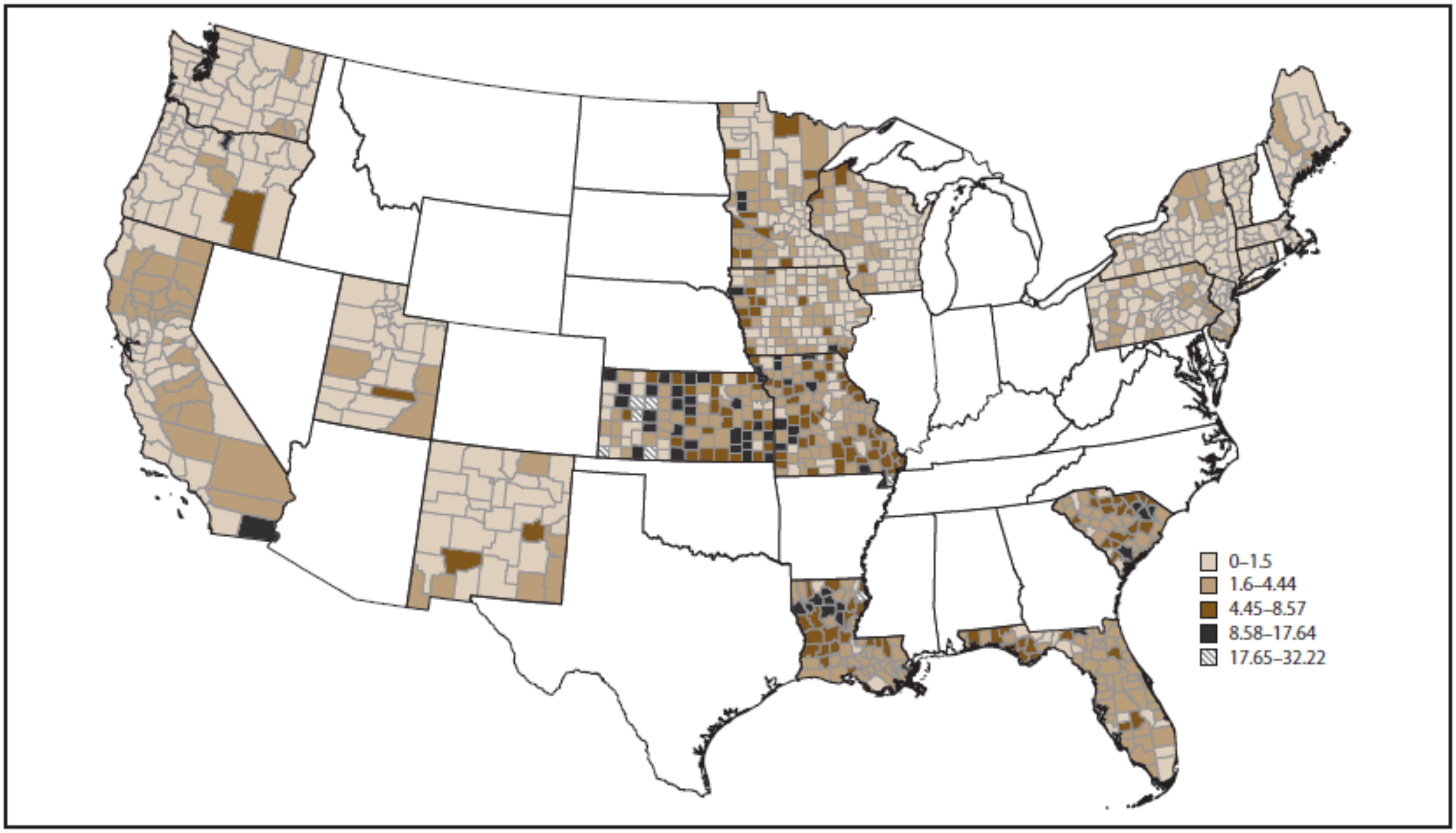
Alternate Text: The figure shows the Environmental Public Health Tracking Network states with the highest crude rates of heat stress illness hospitalizations per 100,000 population during 2001-2010 compared with the overall rate for the 20 states that provided data on heat stress illness hospitalization used in this report. The states with the highest crude rates of heat stress illness hospitalizations were Florida, Louisiana, Kansas, Missouri, and South Carolina.

FIGURE 3. Tracking Network states with the highest age-adjusted rates of heat stress illness hospitalizations per 100,000 population — Environmental Public Health Tracking Program, 20 States, 2001–2010



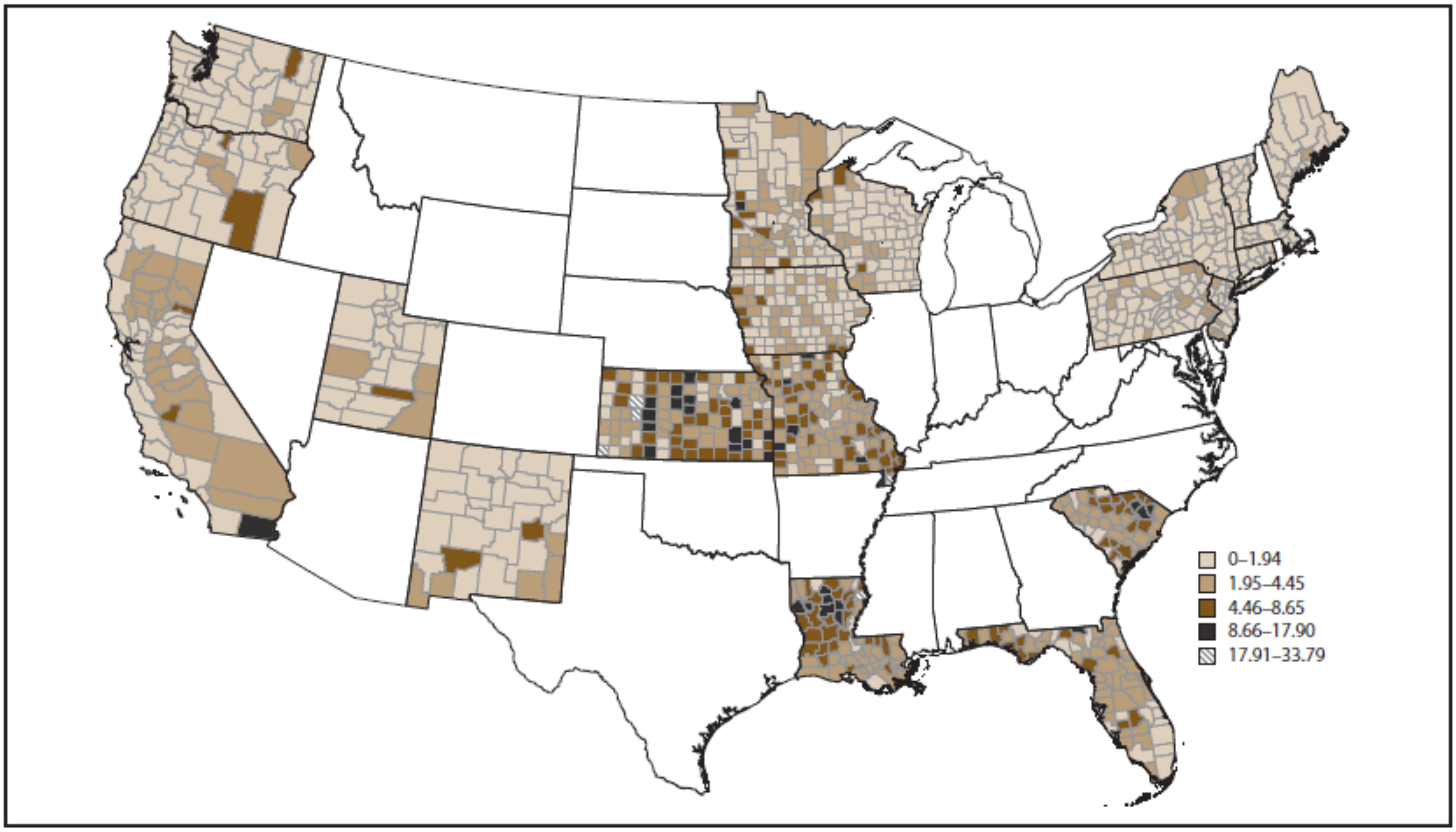
Alternate Text: The figure shows the Environmental Public Health Tracking Network states with the highest age-adjusted rates of heat stress illness hospitalizations per 100,000 population during, 2001-2010 compared with the overall rate for the 23 states that provided age-adjusted data used in this report. The states with the highest age-adjusted rates of heat stress illness hospitalizations were Florida, Louisiana, Kansas, Missouri, and South Carolina.

FIGURE 4. Ten-year average crude rate of heat stress illness hospitalizations per 100,000 population, by county — Environmental Public Health Tracking Network, 20 states, 2001–2010



Alternate Text: The figure shows a map of the United States indicating the average crude rate of heat stress illness hospitalizations per 100,000 population, by county, for 20 states that participated in the Environmental Public Health Tracking Network during 2001-2010.

FIGURE 5. Ten-year average age-adjusted rate of heat stress illness hospitalizations per 100,000 population, by county — Environmental Public Health Tracking Network, 20 states, 2001–2010



Alternate Text: The figure shows a map of the United States indicating the average age-adjusted rate of heat stress illness hospitalizations per 100,000 population, by county, for 20 states that participated in the Environmental Public Health Tracking Network during 2001-2010.

TABLE 4. Average change per year in the rate of heat stress illness hospitalizations — Environmental Public Health Tracking Network, 20 states, 2001–2010

State	IRR	95% CI
California	1.03	1.02–1.04
Connecticut	1.05	1.01–1.08
Florida	1.10	1.08–1.11
Iowa	0.95	0.92–0.97
Kansas	0.98	0.96–1.00
Louisiana	1.03	1.01–1.05
Maine	0.88	0.83–0.93

Massachusetts	0.99	0.97–1.02
Minnesota	0.91	0.89–0.93
Missouri	1.02	1.01–1.04
New Jersey	0.99	0.98–1.01
New Mexico	1.06	1.00–1.11
New York*	0.99	0.97–1.00
Oregon	1.02	0.98–1.06
Pennsylvania	0.99	0.97–1.00
South Carolina	1.05	1.03–1.06
Utah	0.97	0.91–1.02
Vermont	0.94	0.84–1.06
Washington	1.07	1.04–1.11
Wisconsin	0.90	0.87–0.92

Abbreviations: CI = confidence interval; IRR = incidence rate ratio.

* Includes New York City.

TABLE 5. Correlation between the number of monthly heat stress illness hospitalizations and the average monthly maximum temperature at the county level — Environmental Public Health Tracking Network, 20 states, 2001–2010

State	No.	Spearman correlation (ρ)*
Massachusetts	700	0.5
New Jersey	1,050	0.5
Connecticut	400	0.4
New York†	3,100	0.4
Pennsylvania	3,350	0.4
Missouri	5,750	0.3

Maine	800	0.3
South Carolina	2,300	0.3
California	2,900	0.3
Wisconsin	3,600	0.3
Utah	1,450	0.2
Louisiana	3,200	0.2
New Mexico	1,650	0.2
Kansas	5,250	0.2
Iowa	4,950	0.2
Minnesota	4,350	0.2
Washington	1,950	0.2
Oregon	1,800	0.2
Vermont	700	0.2
Florida	3,350	0.1

* $p<0.0001$.

† Includes New York City.

TABLE 6. Correlation between the number of monthly heat stress illness hospitalizations and the average monthly maximum heat index at the county level — Environmental Public Health Tracking Network, 20 states, 2001–2010

State	No.	Spearman correlation (ρ)*
Massachusetts	700	0.5
New Jersey	1,050	0.5
Connecticut	400	0.5
New York†	3,100	0.4
Pennsylvania	3,350	0.4

South Carolina	2,300	0.4
Missouri	5,750	0.3
California	2,900	0.3
Maine	800	0.3
Wisconsin	3,600	0.3
Kansas	5,250	0.3
Louisiana	3,200	0.3
Florida	3,350	0.2
Minnesota	4,350	0.2
Utah	1,450	0.2
Iowa	4,950	0.2
New Mexico	1,650	0.2
Oregon	1,800	0.2
Washington	1,950	0.2
Vermont	700	0.2

* $p < 0.0001$.

† Includes New York City.

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UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

STEPHEN McCOLLUM, and SANDRA McCOLLUM, individually, and STEPHANIE KINGREY, individually and as independent administrator of the Estate of LARRY GENE McCOLLUM, PLAINTIFFS	§ § § § § § §	
v.	§ § §	CIVIL ACTION NO. 4:14-cv-3253 JURY DEMAND
BRAD LIVINGSTON, JEFF PRINGLE, RICHARD CLARK, KAREN TATE, SANDREA SANDERS, ROBERT EASON, the UNIVERSITY OF TEXAS MEDICAL BRANCH and the TEXAS DEPARTMENT OF CRIMINAL JUSTICE. DEFENDANTS	§ § § § § § §	

Plaintiffs' Consolidated Summary Judgment Response Appendix

EXHIBIT 127

QuickFacts

Texas

QuickFacts provides statistics for all states and counties, and for cities and towns with a population of 5,000 or more.

All Topics	TEXAS	UNITED STATES
People		
Population		
Population estimates, July 1, 2015, (V2015)	27,469,114	321,418,820
Population estimates base, April 1, 2010, (V2015)	25,146,105	308,758,105
Population, percent change - April 1, 2010 (estimates base) to July 1, 2015, (V2015)	9.2%	4.1%
Population, Census, April 1, 2010	25,145,561	308,745,538
Age and Sex		
Persons under 5 years, percent, July 1, 2015, (V2015)	7.2%	6.2%
Persons under 5 years, percent, April 1, 2010	7.7%	6.5%
Persons under 18 years, percent, July 1, 2015, (V2015)	26.3%	22.9%
Persons under 18 years, percent, April 1, 2010	27.3%	24.0%
Persons 65 years and over, percent, July 1, 2015, (V2015)	11.7%	14.9%
Persons 65 years and over, percent, April 1, 2010	10.3%	13.0%
Female persons, percent, July 1, 2015, (V2015)	50.4%	50.8%
Female persons, percent, April 1, 2010	50.4%	50.8%
Race and Hispanic Origin		
White alone, percent, July 1, 2015, (V2015) (a)	79.7%	77.1%
White alone, percent, April 1, 2010 (a)	70.4%	72.4%
Black or African American alone, percent, July 1, 2015, (V2015) (a)	12.5%	13.3%
Black or African American alone, percent, April 1, 2010 (a)	11.8%	12.6%
American Indian and Alaska Native alone, percent, July 1, 2015, (V2015) (a)	1.0%	1.2%
American Indian and Alaska Native alone, percent, April 1, 2010 (a)	0.7%	0.9%
Asian alone, percent, July 1, 2015, (V2015) (a)	4.7%	5.6%
Asian alone, percent, April 1, 2010 (a)	3.8%	4.8%
Native Hawaiian and Other Pacific Islander alone, percent, July 1, 2015, (V2015) (a)	0.1%	0.2%
Native Hawaiian and Other Pacific Islander alone, percent, April 1, 2010 (a)	0.1%	0.2%
Two or More Races, percent, July 1, 2015, (V2015)	1.9%	2.6%
Two or More Races, percent, April 1, 2010	2.7%	2.9%
Hispanic or Latino, percent, July 1, 2015, (V2015) (b)	38.8%	17.6%
Hispanic or Latino, percent, April 1, 2010 (b)	37.6%	16.3%
White alone, not Hispanic or Latino, percent, July 1, 2015, (V2015)	43.0%	61.6%
White alone, not Hispanic or Latino, percent, April 1, 2010	45.3%	63.7%
Population Characteristics		
Veterans, 2010-2014	1,564,501	20,700,711
Foreign born persons, percent, 2010-2014	16.5%	13.1%
Housing		
Housing units, July 1, 2015, (V2015)	10,587,752	134,789,944
Housing units, April 1, 2010	9,977,436	131,704,730
Owner-occupied housing unit rate, 2010-2014	62.7%	64.4%
Median value of owner-occupied housing units, 2010-2014	$131,400	$175,700
Median selected monthly owner costs -with a mortgage, 2010-2014	$1,443	$1,522
Median selected monthly owner costs -without a mortgage, 2010-2014	$459	$457
Median gross rent, 2010-2014	$870	$920
Building permits, 2015	175,443	1,182,582
Families and Living Arrangements		
Households, 2010-2014	9,013,582	116,211,092
Persons per household, 2010-2014	2.83	2.63
Living in same house 1 year ago, percent of persons age 1 year+, 2010-2014	83.0%	85.0%
Language other than English spoken at home, percent of persons age 5 years+, 2010-2014	34.9%	20.9%
Education		
High school graduate or higher, percent of persons age 25 years+, 2010-2014	81.6%	86.3%

Bachelor's degree or higher, percent of persons age 25 years+, 2010-2014	27.1%	29.3%
Health		
With a disability, under age 65 years, percent, 2010-2014	8.2%	8.5%
Persons without health insurance, under age 65 years, percent	⚠ 21.3%	⚠ 12.0%
Economy		
In civilian labor force, total, percent of population age 16 years+, 2010-2014	64.4%	63.5%
In civilian labor force, female, percent of population age 16 years+, 2010-2014	57.9%	58.7%
Total accommodation and food services sales, 2012 ($1,000) (c)	54,480,811	708,138,598
Total health care and social assistance receipts/revenue, 2012 ($1,000) (c)	145,035,130	2,040,441,203
Total manufacturers shipments, 2012 ($1,000) (c)	702,603,073	5,696,729,632
Total merchant wholesaler sales, 2012 ($1,000) (c)	691,242,607	5,208,023,478
Total retail sales, 2012 ($1,000) (c)	356,116,376	4,219,821,871
Total retail sales per capita, 2012 (c)	$13,666	$13,443
Transportation		
Mean travel time to work (minutes), workers age 16 years+, 2010-2014	25.2	25.7
Income and Poverty		
Median household income (in 2014 dollars), 2010-2014	$52,576	$53,482
Per capita income in past 12 months (in 2014 dollars), 2010-2014	$26,513	$28,555
Persons in poverty, percent	⚠ 17.2%	⚠ 14.8%
Businesses		
Total employer establishments, 2014	557,721[1]	7,563,085
Total employment, 2014	9,920,214[1]	121,079,879
Total annual payroll, 2014	501,456,595[1]	5,940,442,637
Total employment, percent change, 2013-2014	2.7%[1]	2.4%
Total nonemployer establishments, 2014	2,150,702	23,836,937
All firms, 2012	2,356,748	27,626,360
Men-owned firms, 2012	1,251,696	14,844,597
Women-owned firms, 2012	866,678	9,878,397
Minority-owned firms, 2012	1,070,392	7,952,386
Nonminority-owned firms, 2012	1,224,845	18,987,918
Veteran-owned firms, 2012	213,590	2,521,682
Nonveteran-owned firms, 2012	2,057,218	24,070,685
Geography		
Population per square mile, 2010	96.3	87.4
Land area in square miles, 2010	261,231.71	3,531,905.43
FIPS Code	48	00

1. Includes data not distributed by county.

⚠ This geographic level of poverty and health estimates are not comparable to other geographic levels of these estimates

Some estimates presented here come from sample data, and thus have sampling errors that may render some apparent differences between geographies statistically indistinguishable. Click the Quick Info ⓘ icon to the left of each row in TABLE view to learn about sampling error.

The vintage year (e.g., V2015) refers to the final year of the series (2010 thru 2015).
Different vintage years of estimates are not comparable.

(a) Includes persons reporting only one race
(b) Hispanics may be of any race, so also are included in applicable race categories
(c) Economic Census - Puerto Rico data are not comparable to U.S. Economic Census data

D Suppressed to avoid disclosure of confidential information
F Fewer than 25 firms
FN Footnote on this item in place of data
NA Not available
S Suppressed; does not meet publication standards
X Not applicable
Z Value greater than zero but less than half unit of measure shown

QuickFacts data are derived from: Population Estimates, American Community Survey, Census of Population and Housing, Current Population Survey, Small Area Health Insurance Estimates, Small Area Income and Poverty Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits.

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UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

STEPHEN McCOLLUM, and SANDRA McCOLLUM, individually, and STEPHANIE KINGREY, individually and as independent administrator of the Estate of LARRY GENE McCOLLUM, PLAINTIFFS	§	
v.	§	CIVIL ACTION NO. 4:14-cv-3253 JURY DEMAND
BRAD LIVINGSTON, JEFF PRINGLE, RICHARD CLARK, KAREN TATE, SANDREA SANDERS, ROBERT EASON, the UNIVERSITY OF TEXAS MEDICAL BRANCH and the TEXAS DEPARTMENT OF CRIMINAL JUSTICE. DEFENDANTS	§	

Plaintiffs' Consolidated Summary Judgment Response Appendix

EXHIBIT 128

U.S. Census Bureau News
Joint Release
U.S. Department of Housing and Urban Development

U.S. Department of Commerce • Washington, D.C. 20233

FOR IMMEDIATE RELEASE TUESDAY, AUGUST 16, 2016 AT 8:30 A.M. EDT

CB16-133

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NEW RESIDENTIAL CONSTRUCTION IN JULY 2016

The U.S. Census Bureau and the Department of Housing and Urban Development jointly announced the following new residential construction statistics for July 2016:

BUILDING PERMITS

Privately-owned housing units authorized by building permits in July were at a seasonally adjusted annual rate of 1,152,000. This is 0.1 percent (±1.2%)* below the revised June rate of 1,153,000, but is 0.9 percent (±1.5%)* above the July 2015 estimate of 1,142,000.

Single-family authorizations in July were at a rate of 711,000; this is 3.7 percent (±1.4%) below the revised June figure of 738,000. Authorizations of units in buildings with five units or more were at a rate of 411,000 in July.

HOUSING STARTS

Privately-owned housing starts in July were at a seasonally adjusted annual rate of 1,211,000. This is 2.1 percent (±8.8%)* above the revised June estimate of 1,186,000 and is 5.6 percent (±14.7%)* above the July 2015 rate of 1,147,000.

Single-family housing starts in July were at a rate of 770,000; this is 0.5 percent (±8.6%)* above the revised June figure of 766,000. The July rate for units in buildings with five units or more was 433,000.

HOUSING COMPLETIONS

Privately-owned housing completions in July were at a seasonally adjusted annual rate of 1,026,000. This is 8.3 percent (±8.9%)* below the revised June estimate of 1,119,000, but is 3.2 percent (±11.2%)* above the July 2015 rate of 994,000.

Single-family housing completions in July were at a rate of 743,000; this is 0.4 percent (±8.8%)* below the revised June rate of 746,000. The July rate for units in buildings with five units or more was 275,000.

New Residential Construction data for August 2016 will be released on Tuesday, September 20, 2016, at 8:30 A.M. EDT.
Our Internet site is: http://www.census.gov/starts

To learn more about this release and the other indicators the U.S. Census Bureau publishes, join us for the Investigating Economic Indicators Webinar Series. For more information, visit www.census.gov/econ/webinar.

To receive the latest updates on the Nation's key economic indicators, download the America's Economy app for Apple and Android smartphones and tablets.

EXPLANATORY NOTES

In interpreting changes in the statistics in this release, note that month-to-month changes in seasonally adjusted statistics often show movements which may be irregular. It may take 3 months to establish an underlying trend for building permit authorizations, 6 months for total starts, and 6 months for total completions. The statistics in this release are estimated from sample surveys and are subject to sampling variability as well as nonsampling error including bias and variance from response, nonreporting, and undercoverage. Estimated relative standard errors of the most recent data are shown in the tables. Whenever a statement such as "2.5 percent (±3.2%) above" appears in the text, this indicates the range (-0.7 to +5.7 percent) in which the actual percent change is likely to have occurred. All ranges given for percent changes are 90-percent confidence intervals and account only for sampling variability. If a range does not contain zero, the change is statistically significant. If it does contain zero, the change is not statistically significant; that is, it is uncertain whether there was an increase or decrease. The same policies apply to the confidence intervals for percent changes shown in the tables. On average, the preliminary seasonally adjusted estimates of total building permits, housing starts and housing completions are revised two percent or less. Explanations of confidence intervals and sampling variability can be found on our web site listed above.

* 90% confidence interval includes zero. The Census Bureau does not have sufficient statistical evidence to conclude that the actual change is different from zero.

Table 1. New Privately-Owned Housing Units Authorized in Permit-Issuing Places

[Thousands of units. Detail may not add to total because of rounding]

Period	United States				Northeast		Midwest		South		West	
		In structures with --										
	Total	1 unit	2 to 4 units	5 units or more	Total	1 unit	Total	1 unit	Total	1 unit	Total	1 unit
	Seasonally adjusted annual rate											
2015: July	1,142	694	30	418	113	56	172	108	587	371	270	159
August	1,166	710	30	426	110	60	177	104	589	380	290	166
September	1,129	708	38	383	115	55	173	104	562	389	279	160
October	1,175	725	35	415	130	54	176	106	601	400	268	165
November	1,286	735	29	522	124	57	209	108	635	396	318	174
December	1,201	738	35	428	180	58	167	112	582	399	272	169
2016: January	1,188	727	35	426	87	54	208	113	576	390	317	170
February	1,162	733	33	396	125	52	186	121	566	384	285	176
March	1,077	725	34	318	101	52	183	120	540	387	253	166
April	1,130	741	32	357	103	56	195	113	558	396	274	176
May	1,136	731	28	377	96	51	177	112	545	399	318	169
June (r)	1,153	738	29	386	108	58	172	112	585	396	288	172
July (p)	**1,152**	**711**	**30**	**411**	**97**	**51**	**190**	**108**	**600**	**390**	**265**	**162**
Average RSE (%)[1]	2	2	5	2	3	4	4	4	1	1	2	2
Percent Change:												
July 2016 from June 2016	***-0.1%***	***-3.7%***	***3.4%***	***6.5%***	***-10.2%***	***-12.1%***	***10.5%***	***-3.6%***	***2.6%***	***-1.5%***	***-8.0%***	***-5.8%***
90% Confidence Interval[3]	*± 1.2*	*± 1.4*	*± 8.3*	*± 1.7*	*± 4.3*	*± 4.6*	*± 3.7*	*± 2.4*	*± 1.0*	*± 1.2*	*± 2.3*	*± 3.7*
July 2016 from July 2015	***0.9%***	***2.4%***	***0.0%***	***-1.7%***	***-14.2%***	***-8.9%***	***10.5%***	***0.0%***	***2.2%***	***5.1%***	***-1.9%***	***1.9%***
90% Confidence Interval[3]	*± 1.5*	*± 1.6*	*± 7.2*	*± 2.7*	*± 2.5*	*± 4.7*	*± 4.0*	*± 3.0*	*± 2.7*	*± 1.2*	*± 1.7*	*± 3.1*
	Not seasonally adjusted											
2014:	1,052.1	640.3	29.9	382.0	118.5	54.6	165.2	101.0	524.1	347.7	244.3	137.1
2015:	1,182.6	696.0	32.1	454.5	162.0	52.4	170.6	104.7	572.8	378.2	277.2	160.7
RSE (%)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)	(X)
2015: Year to Date[2]	696.4	410.2	18.3	267.8	105.8	28.5	94.0	61.3	333.7	224.3	162.9	96.1
2016: Year to Date[2]	681.4	439.7	18.4	223.2	60.6	30.7	105.7	66.0	342.5	239.1	172.6	103.9
RSE (%)	2	2	2	1	2	3	4	4	1	1	1	2
Year to Date Percent Change[4]	***-2.2%***	***7.2%***	***0.6%***	***-16.7%***	***-42.7%***	***7.7%***	***12.5%***	***7.7%***	***2.6%***	***6.6%***	***6.0%***	***8.1%***
90% Confidence Interval[3]	*± 0.5*	*± 0.4*	*± 5.6*	*± 1.2*	*± 1.1*	*± 2.9*	*± 2.5*	*± 1.2*	*± 0.8*	*± 0.4*	*± 0.9*	*± 1.2*
2015: July	103.2	65.9	2.7	34.6	10.7	5.4	16.5	10.9	51.3	34.1	24.7	15.4
August	98.4	62.0	2.7	33.7	9.6	5.2	16.0	9.8	48.6	32.7	24.1	14.3
September	98.3	60.3	3.5	34.5	10.5	5.1	17.6	9.9	47.0	32.1	23.2	13.2
October	99.3	60.3	3.2	35.9	10.6	4.8	17.1	10.1	50.4	32.2	21.2	13.2
November	91.0	50.0	2.1	39.0	9.7	4.3	15.6	7.4	43.6	26.7	22.2	11.5
December	97.5	51.3	2.8	43.5	16.2	4.1	11.1	6.5	47.7	28.6	22.4	12.2
2016: January	74.8	45.7	2.1	27.0	5.0	3.0	9.6	4.9	40.2	27.2	19.9	10.6
February	84.5	53.0	2.3	29.1	7.3	3.1	9.7	6.6	45.2	30.6	22.3	12.8
March	97.7	67.5	2.9	27.3	8.0	4.5	15.4	10.4	50.8	37.2	23.6	15.4
April	99.7	68.0	2.6	29.1	8.5	5.1	17.9	10.8	48.8	36.0	24.5	16.0
May	107.7	70.2	2.7	34.9	9.1	5.0	17.8	11.7	50.9	36.9	29.9	16.6
June (r)	114.4	74.7	2.8	36.9	12.3	5.9	17.5	12.1	55.2	38.3	29.3	18.4
July (p)	**95.8**	**61.0**	**2.5**	**32.2**	**8.3**	**4.5**	**16.8**	**9.7**	**49.0**	**32.6**	**21.6**	**14.1**
Average RSE (%)[1]	2	2	5	2	3	4	4	4	1	1	2	2

(p) Preliminary. (r) Revised. RSE Relative standard error. S Does not meet publication standards because tests for identifiable and stable seasonality do not meet reliability standards.
X Not applicable. Z Relative standard error is less than 0.5 percent.
[1]Average RSE for the latest 6-month period. [2]Reflects revisions not distributed to months.
[3] See the Explanatory Notes in the accompanying text for an explanation of 90% confidence intervals. [4] Computed using unrounded data.

Table 2. New Privately-Owned Housing Units Authorized, but Not Started, at End of Period

[Thousands of units. Detail may not add to total because of rounding]

Period	United States				Northeast		Midwest		South		West	
		In structures with --										
	Total	1 unit	2 to 4 units	5 units or more	Total	1 unit	Total	1 unit	Total	1 unit	Total	1 unit
	Seasonally adjusted											
2015: July	146	63	(S)	81	29	6	14	8	74	37	29	12
August	146	63	(S)	80	28	6	16	9	72	35	30	13
September	135	63	(S)	70	25	7	18	9	65	34	27	13
October	143	67	(S)	74	26	7	18	9	73	38	26	13
November	143	65	(S)	76	25	6	20	9	70	37	28	13
December	149	66	(S)	80	27	6	20	10	73	37	29	13
2016: January	152	70	(S)	80	23	6	22	10	72	40	35	14
February	150	66	(S)	82	25	6	19	9	72	37	34	14
March	146	66	(S)	78	22	6	17	9	75	37	32	14
April	143	66	(S)	76	20	6	15	8	73	36	35	16
May (r)	142	68	(S)	73	21	6	15	8	69	37	37	17
June (r)	140	67	(S)	71	20	5	14	8	68	37	38	17
July (p)	**133**	**65**	**(S)**	**66**	**20**	**6**	**16**	**8**	**62**	**34**	**35**	**17**
Average RSE (%)[1]	6	6	(X)	10	14	16	19	15	9	10	9	12
Percent Change: [2]												
July 2016 from June 2016	***-5.0%***	***-3.0%***	***(S)***	***-7.0%***	***0.0%***	***20.0%***	***14.3%***	***0.0%***	***-8.8%***	***-8.1%***	***-7.9%***	***0.0%***
90% Confidence Interval [3]	*± 4.5*	*± 5.4*	*(X)*	*± 7.6*	*± 9.0*	*± 13.6*	*± 12.6*	*± 12.4*	*± 7.5*	*± 7.0*	*± 8.7*	*± 13.5*
July 2016 from July 2015	***-8.9%***	***3.2%***	***(S)***	***-18.5%***	***-31.0%***	***0.0%***	***14.3%***	***0.0%***	***-16.2%***	***-8.1%***	***20.7%***	***41.7%***
90% Confidence Interval [3]	*± 10.3*	*± 10.1*	*(X)*	*± 14.2*	*± 15.4*	*± 24.5*	*± 18.6*	*± 18.4*	*± 16.4*	*± 12.2*	*± 25.6*	*± 30.7*
	Not seasonally adjusted											
2015: July	151.2	66.7	2.2	82.3	29.9	6.5	14.7	8.9	77.0	38.6	29.6	12.7
August	148.7	63.8	2.6	82.4	28.8	6.3	16.1	9.3	74.4	35.2	29.4	13.0
September	135.3	63.6	1.9	69.8	25.2	6.9	19.4	9.4	64.7	34.3	26.1	13.0
October	139.9	65.3	2.0	72.6	23.6	6.3	20.1	8.7	71.0	37.0	25.1	13.3
November	133.1	60.2	2.0	70.9	23.1	5.5	18.4	7.6	66.2	34.7	25.4	12.3
December	146.3	63.6	2.5	80.1	27.2	5.9	17.5	8.4	72.2	35.8	29.4	13.5
2016: January	146.4	66.1	2.3	78.0	22.6	5.5	19.3	8.8	72.8	38.1	31.7	13.8
February	146.8	62.4	2.0	82.4	25.9	5.8	17.0	7.8	70.7	35.3	33.1	13.5
March	151.5	70.1	1.8	79.5	21.8	6.0	19.3	10.6	76.1	38.8	34.3	14.7
April	144.4	68.2	1.2	75.0	19.4	6.2	15.9	8.2	72.3	37.7	36.9	16.1
May (r)	145.1	70.4	1.5	73.3	20.7	6.4	15.0	9.0	68.9	37.9	40.5	17.0
June (r)	149.9	73.1	1.7	75.1	22.9	5.7	14.9	9.3	71.7	39.3	40.4	18.8
July (p)	**133.6**	**64.8**	**1.8**	**67.0**	**19.9**	**5.7**	**14.7**	**8.1**	**64.4**	**34.4**	**34.7**	**16.6**
Average RSE (%)[1]	6	6	85	10	14	16	19	15	9	10	9	12

(p) Preliminary. (r) Revised. RSE Relative standard error. S Does not meet publication standards because tests for identifiable and stable seasonality do not meet reliability standards.
Z Relative standard error is less than 0.5 percent.

[1] Average RSE for the latest 6-month period.

[2] Computed using unrounded data.

[3] See the Explanatory Notes in the accompanying text for an explanation of 90% confidence intervals.

Note: These data represent the number of housing units authorized in all months up to and including the last day of the reporting period and not started as of that date without regard to the months of original permit issuance. Cancelled, abandoned, expired, and revoked permits are excluded.

Table 3. New Privately-Owned Housing Units Started

[Thousands of units. Detail may not add to total because of rounding]

Period	United States				Northeast		Midwest		South		West	
	Total	In structures with -- 1 unit	2 to 4 units	5 units or more	Total	1 unit	Total	1 unit	Total	1 unit	Total	1 unit
	Seasonally adjusted annual rate											
2015: July	1,147	760	(S)	376	159	71	171	120	552	390	265	179
August	1,132	731	(S)	394	113	55	146	105	625	427	248	144
September	1,189	743	(S)	435	127	56	137	112	630	408	295	167
October	1,073	714	(S)	347	136	59	176	116	515	374	246	165
November	1,171	786	(S)	379	125	66	169	109	609	423	268	188
December	1,160	765	(S)	378	156	63	164	112	591	420	249	170
2016: January	1,128	775	(S)	335	148	64	155	129	579	425	246	157
February	1,213	845	(S)	356	80	57	211	161	612	429	310	198
March	1,113	751	(S)	353	154	58	159	116	540	400	260	177
April	1,155	764	(S)	378	119	55	203	130	596	423	237	156
May (r)	1,128	737	(S)	386	81	56	191	108	587	412	269	161
June (r)	1,186	766	(S)	400	116	71	171	115	592	413	307	167
July (p)	**1,211**	**770**	**(S)**	**433**	**134**	**54**	**175**	**112**	**613**	**429**	**289**	**175**
Average RSE (%)[1]	5	5	(X)	13	15	13	11	9	8	7	10	9
Percent Change:												
July 2016 from June 2016	***2.1%***	***0.5%***	***(S)***	***8.3%***	***15.5%***	***-23.9%***	***2.3%***	***-2.6%***	***3.5%***	***3.9%***	***-5.9%***	***4.8%***
90% Confidence Interval[2]	*± 8.8*	*± 8.6*	*(X)*	*± 26.0*	*± 32.0*	*± 17.9*	*± 23.3*	*± 16.6*	*± 12.1*	*± 14.3*	*± 17.6*	*± 18.1*
July 2016 from July 2015	***5.6%***	***1.3%***	***(S)***	***15.2%***	***-15.7%***	***-23.9%***	***2.3%***	***-6.7%***	***11.1%***	***10.0%***	***9.1%***	***-2.2%***
90% Confidence Interval[2]	*± 14.7*	*± 9.1*	*(X)*	*± 44.2*	*± 22.4*	*± 23.0*	*± 20.5*	*± 17.6*	*± 28.2*	*± 15.4*	*± 19.8*	*± 16.9*
	Not seasonally adjusted											
2014:	1,003.3	647.9	13.7	341.7	109.6	51.3	162.5	105.7	496.3	345.9	235.0	145.1
2015:	1,111.8	714.5	11.5	385.8	138.1	54.8	152.6	107.3	555.5	387.1	265.6	165.2
RSE (%)	2	1	15	5	5	3	4	3	2	2	3	2
2015: Year to Date	642.2	417.0	7.1	218.1	82.0	29.5	85.3	60.1	314.3	225.8	160.5	101.6
2016: Year to Date	685.0	461.3	6.9	216.8	67.8	33.9	102.1	69.1	351.0	253.8	164.1	104.4
RSE (%)	2	1	22	6	5	4	4	4	3	2	4	3
Year to Date Percent Change[3]	***6.7%***	***10.6%***	***-2.7%***	***-0.6%***	***-17.4%***	***15.1%***	***19.7%***	***15.0%***	***11.7%***	***12.4%***	***2.2%***	***2.8%***
90% Confidence Interval[2]	*± 4.8*	*± 3.3*	*± 31.5*	*± 12.7*	*± 9.1*	*± 10.8*	*± 8.8*	*± 6.6*	*± 8.2*	*± 5.2*	*± 7.3*	*± 6.1*
2015: July	107.2	71.8	1.0	34.5	14.8	6.7	17.1	12.4	50.0	35.2	25.3	17.5
August	99.2	66.4	0.5	32.2	9.9	5.2	13.7	10.3	54.2	38.0	21.4	12.9
September	111.6	65.0	1.1	45.5	12.4	5.0	13.6	11.1	58.3	35.1	27.2	13.9
October	90.9	58.9	1.1	30.9	12.3	5.4	16.5	11.2	42.2	29.7	19.7	12.6
November	89.9	57.0	0.5	32.5	10.4	5.3	13.6	8.4	45.8	29.8	20.2	13.3
December	78.1	50.2	1.2	26.7	11.0	4.4	9.9	6.2	40.7	28.6	16.5	10.9
2016: January	74.3	50.2	1.3	22.9	9.5	3.7	7.5	5.7	40.4	29.9	17.0	10.9
February	84.1	58.0	0.8	25.3	4.6	3.0	10.8	7.3	46.8	33.8	21.9	13.9
March	90.7	62.2	0.7	27.8	11.9	4.3	11.4	8.0	45.7	34.6	21.8	15.2
April	106.2	72.5	1.1	32.6	10.8	5.3	19.3	13.0	54.1	39.2	22.0	15.0
May (r)	105.0	70.2	0.5	34.3	7.5	5.3	18.6	11.1	54.1	38.5	24.9	15.2
June (r)	110.6	75.4	1.7	33.5	11.0	7.3	17.0	12.3	54.0	39.0	28.6	16.9
July (p)	**114.0**	**72.7**	**0.8**	**40.5**	**12.5**	**5.1**	**17.5**	**11.6**	**55.9**	**38.7**	**28.0**	**17.4**
Average RSE (%)[1]	5	5	45	13	15	13	11	9	8	7	10	9

(p) Preliminary. (r) Revised. RSE Relative standard error. S Does not meet publication standards because tests for identifiable and stable seasonality do not meet reliability standards.
X Not applicable. Z Relative standard error is less than 0.5 percent.

[1] Average RSE for the latest 6-month period.

[2] See the Explanatory Notes in the accompanying text for an explanation of 90% confidence intervals.

[3] Computed using unrounded data.

Table 4. New Privately-Owned Housing Units Under Construction at End of Period

[Thousands of units. Detail may not add to total because of rounding]

Period	United States				Northeast		Midwest		South		West	
	Total	In structures with -- 1 unit	2 to 4 units	5 units or more	Total	1 unit	Total	1 unit	Total	1 unit	Total	1 unit
	Seasonally adjusted											
2015: July	906	387	(S)	507	165	46	127	65	386	188	228	88
August	917	392	(S)	514	167	46	126	65	396	194	228	87
September	935	398	(S)	526	169	46	120	65	410	199	236	88
October	943	404	(S)	528	172	47	123	66	411	202	237	89
November	964	415	(S)	538	173	48	128	69	423	205	240	93
December	976	419	(S)	546	179	49	130	68	429	208	238	94
2016: January	976	421	(S)	544	181	49	130	70	428	209	237	93
February	987	428	(S)	549	181	49	136	74	431	212	239	93
March	991	427	(S)	554	187	49	131	73	430	209	243	96
April	995	430	(S)	555	187	49	134	74	432	212	242	95
May (r)	1,009	429	(S)	570	190	50	136	72	436	211	247	96
June (r)	1,018	430	(S)	577	188	50	139	71	441	213	250	96
July (p)	**1,037**	**432**	**(S)**	**594**	**194**	**51**	**139**	**70**	**446**	**214**	**258**	**97**
Average RSE (%)[1]	3	2	(X)	5	8	6	4	6	3	4	5	4
Percent Change:												
July 2016 from June 2016	***1.9%***	***0.5%***	***(S)***	***2.9%***	***3.2%***	***2.0%***	***0.0%***	***-1.4%***	***1.1%***	***0.5%***	***3.2%***	***1.0%***
90% Confidence Interval[2]	*± 1.0*	*± 1.3*	*(X)*	*± 1.6*	*± 1.8*	*± 2.4*	*± 2.0*	*± 3.3*	*± 1.7*	*± 2.3*	*± 2.9*	*± 4.0*
July 2016 from July 2015	***14.5%***	***11.6%***	***(S)***	***17.2%***	***17.6%***	***10.9%***	***9.4%***	***7.7%***	***15.5%***	***13.8%***	***13.2%***	***10.2%***
90% Confidence Interval[2]	*± 4.5*	*± 3.5*	*(X)*	*± 7.9*	*± 13.9*	*± 10.7*	*± 9.6*	*± 8.8*	*± 6.4*	*± 5.9*	*± 7.9*	*± 6.9*
	Not seasonally adjusted											
2015: July	926.8	405.0	11.7	510.1	166.0	46.7	131.0	68.7	395.1	196.0	234.6	93.6
August	932.6	412.3	11.3	509.0	167.7	47.7	129.5	69.1	403.0	202.6	232.4	92.9
September	953.1	417.4	11.3	524.4	170.2	47.6	124.2	69.3	418.1	207.7	240.6	92.9
October	951.7	415.0	11.2	525.5	171.7	47.5	126.7	70.2	414.3	205.8	239.0	91.5
November	967.7	416.3	10.7	540.7	174.4	48.4	129.9	70.8	424.1	205.2	239.4	92.0
December	950.8	397.6	11.0	542.3	176.8	48.0	127.8	66.3	415.9	196.0	230.4	87.2
2016: January	950.2	399.0	10.9	540.3	178.7	47.4	125.1	66.0	416.1	198.3	230.4	87.4
February	958.6	404.7	10.1	543.8	178.2	47.2	128.7	67.3	419.5	202.4	232.2	87.7
March	969.4	408.6	9.9	550.8	184.9	47.8	125.0	67.7	421.6	201.9	237.9	91.3
April	994.2	424.1	10.2	559.9	187.7	48.5	132.0	71.1	431.4	210.1	243.1	94.5
May (r)	1,018.4	432.2	10.0	576.2	191.2	49.7	136.8	71.7	441.6	214.0	248.9	96.7
June (r)	1,034.5	442.5	10.6	581.5	190.4	51.1	141.3	73.2	447.8	218.3	255.1	99.8
July (p)	**1,060.2**	**451.6**	**10.6**	**598.0**	**195.8**	**52.0**	**143.2**	**73.9**	**456.5**	**222.8**	**264.8**	**102.9**
Average RSE (%)[1]	3	2	14	5	8	6	4	6	3	4	5	4

(p) Preliminary. (r) Revised. RSE Relative standard error. S Does not meet publication standards because tests for identifiable and stable seasonality do not meet reliability standards.
X Not applicable. Z Relative standard error is less than 0.5 percent.

[1]Average RSE for the latest 6-month period. [2] See the Explanatory Notes in the accompanying text for an explanation of 90% confidence intervals.

Table 5. New Privately-Owned Housing Units Completed

[Thousands of units. Detail may not add to total because of rounding]

Period	United States Total	United States: In structures with -- 1 unit	United States: In structures with -- 2 to 4 units	United States: In structures with -- 5 units or more	Northeast Total	Northeast 1 unit	Midwest Total	Midwest 1 unit	South Total	South 1 unit	West Total	West 1 unit
	Seasonally adjusted annual rate											
2015: July	994	639	(S)	344	90	46	171	101	510	335	223	157
August	963	664	(S)	292	76	49	155	106	482	358	250	151
September	1,010	644	(S)	359	116	48	211	113	450	330	233	153
October	984	640	(S)	335	116	48	154	100	487	343	227	149
November	973	642	(S)	317	106	54	113	84	497	364	257	140
December	1,033	708	(S)	316	90	49	153	115	504	381	286	163
2016: January	1,056	691	(S)	348	98	60	144	103	539	383	275	145
February	1,025	732	(S)	272	80	57	140	91	529	388	276	196
March	1,063	730	(S)	324	110	65	170	118	553	403	230	144
April	952	708	(S)	235	85	57	149	118	500	381	218	152
May (r)	1,015	724	(S)	282	69	47	173	125	538	394	235	158
June (r)	1,119	746	(S)	364	121	61	186	137	563	390	249	158
July (p)	**1,026**	**743**	**(S)**	**275**	**85**	**46**	**174**	**126**	**525**	**406**	**242**	**165**
Average RSE (%)[1]	5	5	(X)	14	16	16	12	11	7	7	11	12
Percent Change:												
July 2016 from June 2016	***-8.3%***	***-0.4%***	***(S)***	***-24.5%***	***-29.8%***	***-24.6%***	***-6.5%***	***-8.0%***	***-6.7%***	***4.1%***	***-2.8%***	***4.4%***
90% Confidence Interval[2]	*± 8.9*	*± 8.8*	*(X)*	*± 19.6*	*± 32.6*	*± 22.2*	*± 19.3*	*± 28.4*	*± 13.0*	*± 13.9*	*± 30.0*	*± 27.8*
July 2016 from July 2015	***3.2%***	***16.3%***	***(S)***	***-20.1%***	***-5.6%***	***0.0%***	***1.8%***	***24.8%***	***2.9%***	***21.2%***	***8.5%***	***5.1%***
90% Confidence Interval[2]	*± 11.2*	*± 10.1*	*(X)*	*± 21.3*	*± 47.5*	*± 37.6*	*± 14.2*	*± 19.3*	*± 15.0*	*± 17.2*	*± 26.3*	*± 19.9*
	Not seasonally adjusted											
2014:	883.8	619.5	8.7	255.6	88.5	49.3	148.8	103.4	441.0	329.0	205.5	137.7
2015:	968.2	647.9	10.0	310.3	92.6	46.6	154.4	102.7	489.8	351.9	231.5	146.7
RSE (%)	2	2	18	6	8	5	3	4	3	3	3	2
2015: Year to Date	517.6	347.0	5.9	164.7	46.6	23.3	79.7	52.9	273.5	193.4	117.8	77.5
2016: Year to Date	564.8	395.8	6.2	162.9	49.6	29.5	86.7	62.0	295.1	217.6	133.4	86.7
RSE (%)	2	2	20	5	7	8	4	2	3	3	3	4
Year to Date Percent Change[3]	***9.1%***	***14.1%***	***4.4%***	***-1.1%***	***6.4%***	***26.6%***	***8.8%***	***17.2%***	***7.9%***	***12.5%***	***13.3%***	***11.9%***
90% Confidence Interval[2]	*± 5.2*	*± 4.8*	*± 34.6*	*± 10.9*	*± 23.2*	*± 14.4*	*± 10.3*	*± 8.7*	*± 6.7*	*± 6.6*	*± 7.3*	*± 7.9*
2015: July	86.3	52.1	1.1	33.2	8.2	3.9	15.3	8.5	43.7	26.8	19.1	12.7
August	92.1	58.6	0.8	32.7	6.9	4.0	15.3	9.8	45.3	31.4	24.6	13.5
September	92.6	58.0	0.7	33.9	11.6	5.1	19.9	10.6	40.0	28.8	21.1	13.5
October	89.5	60.0	0.8	28.7	10.7	4.9	14.7	10.1	43.6	31.2	20.5	13.8
November	80.9	55.2	1.1	24.6	8.5	4.5	10.2	7.9	40.3	30.0	21.8	12.7
December	95.6	69.0	0.8	25.8	8.2	4.8	14.6	11.5	47.1	37.1	25.7	15.6
2016: January	72.5	46.7	1.2	24.6	6.8	4.1	9.3	6.4	37.7	26.7	18.7	9.5
February	71.2	51.4	1.4	18.3	5.0	3.4	9.5	6.2	38.0	28.4	18.8	13.4
March	78.8	55.4	0.7	22.7	7.3	4.2	11.7	8.0	42.4	31.8	17.5	11.4
April	73.8	55.6	0.7	17.6	6.5	4.4	11.5	9.2	39.0	30.2	16.8	11.8
May (r)	83.5	60.2	0.7	22.6	5.6	3.8	14.0	10.2	44.4	33.0	19.5	13.3
June (r)	97.3	65.3	0.8	31.2	10.9	5.7	15.4	11.3	49.5	34.7	21.4	13.6
July (p)	**87.7**	**61.1**	**0.7**	**25.8**	**7.5**	**3.8**	**15.2**	**10.8**	**44.1**	**32.9**	**20.9**	**13.7**
Average RSE (%)[1]	5	5	39	14	16	16	12	11	7	7	11	12

(p) Prelminary. (r) Revised. RSE Relative standard error. S Does not meet publication standards because tests for identifiable and stable seasonality do not meet reliability standards.
X Not applicable. Z Relative standard error is less than 0.5 percent.
[1] Average RSE for the latest 6-month period. [2] See the Explanatory Notes in the accompanying text for an explanation of 90% confidence intervals.
[3] Computed using unrounded data.